DEPLOYMENT CHALLENGES

FOR

COOPERATIVE SYSTEMS

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ABBREVIATIONS & DEFINITIONS

For the purposes of the present document, the following definitions apply:

V2I, I2V: direct Vehicle to road Infrastructure communication using a wireless local area network such as standardized in EN 302 571

V2V: direct Vehicle(s) to Vehicle(s) communication using a wireless local area network such as standardized in EN 302 571

V2X: from Vehicle to Vehicle (V2V); from Vehicle to Infrastructure (V2I); and from Infrastructure to Vehicle (I2V).

Abbreviation	**Definition**
3G	International Mobile Telecommunications – 2000 (IMT-2000), better known as 3G or 3rd Generation. A family of standards for mobile telecommunications defined by the International Telecommunications Union which includes GSM EDGE, UMTS and CDMA2000 and DECT and WiMAX.
ADR	European Agreement related to International Dangerous Goods Road Transport
CEN	European Committee for Standardisation (Comité Européen de Normalisation)
CENELEC	European Committee for Electrotechnical Standardisation
CVIS	Co-operative Vehicle Infrastructure System
DEPN	DEployment ENablers
DGINFSO	Directorate General Information Society and Media
EC	European Commission
EDPS	European Data Protection Supervisor
ETSI	European Telecommunications Standards Institute
FOAM	CVIS sub-project which objective is to create an open execution environment in which CVIS applications can be developed, delivered, executed and maintained during the lifecycle of in-vehicle and roadside equipment

GPS	Global Positioning System
GST-SEC	Global System for Telematics Security
HMI	Human Machine Interface
ICT	Information Communications Technology
IR	Infra-red
ISO	International Organization for Standardisation
ITS	Intelligent Transport Systems
OBU	On Board Unit
OEM	Original Equipment Manufacturer
PET	Privacy Enhancing Technology
R&D	Research & Development
RSU	Road Side Unit
SeVeCom	Secure Vehicular Communications
SP	Sub-Project
UC	Use Case
TfL	Transport for London
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
VMS	Variable Messaging System

EXECUTIVE SUMMARY

This white paper is to create a common basis between the 3 6^{th} frameworks IP's, focusing on cooperative systems, providing a vision on issues for the deployment of such systems and recommend actions to be taken by stakeholders. This white paper focuses on the non-technical challenges the deployment of cooperative systems is facing and can be divided into three parts:

- Identification of the challenges
- Actions for stakeholders to overcome the challenges
- Visions on the deployment of cooperative systems

The subjects for deployment are derived from the various sub-projects involved with deployment. The overlap between the subprojects of the 3 IP's, although not anticipated in the beginning, provided a common basis, which lead to the idea of producing this white paper.

The subjects discussed are the following:

- Technology
- Standardisation & Interoperability
- Liability
- User acceptance
- Privacy & Security
- Business "Modelling" & Organisational
- Political
- Deployment & Operation

The actions to overcome the deployment challenges coming from these subjects are for the five main involved stakeholders, knowingly Public authorities, Road operators, OEM's, Suppliers and Service providers. The vision for deployment is presented in the last chapter where the synergies between deployment scenarios for the various projects are projected.

INTRODUCTION

The White paper is a joint initiative by the FP6 research projects CVIS, SAFESPOT and COOPERS. The aim is to produce a common view on the most important non technical issues for Cooperatives Systems Deployment.

Cooperative systems deployment should ensure that the core technologies and applications as developed in the 3 IP projects CVIS, SAFESPOT, COOPERS are fundamentally deployable and that non-technical issues have been identified and their potential impact on deployment described along with recommendations as to how these issues could be addressed. Each IP is addressing non-technical issues and this white paper consolidates the view of the three IP's. This paper underlines the potential challenges to deployment that might be experienced and puts in place solutions or recommendations for them.

DEPLOYMENT CHALLENGES

The list of challenges has been derived from the three large projects, which all followed their own process for identifying deployment challenges. The list given here covers common challenges and gives hints for potential actions. The focus of the deployment challenges are formulated from the business point of view, i.e. which non-technical aspects are still hampering the full-scale deployment of these systems.

- Technology
- Standardisation & Interoperability
- Liability
- User acceptance
- Privacy & Security
- Business "Modelling" & Organisational
- Political
- Deployment & Operation

1. Technology

1.1 Challenges

The CVIS, SAFESPOT and COOPERS projects aim to improve road safety and traffic efficiency by dealing with cooperative systems as suggested by their acronyms.

Their vision is what makes them different:

• **CVIS** consists in designing and testing a core technology for cooperation of systems

• **SAFESPOT** is focussed on cooperative systems for the processing of highly safety critical tasks

• **COOPERS** uses the road operators' view for the conception of cooperative systems

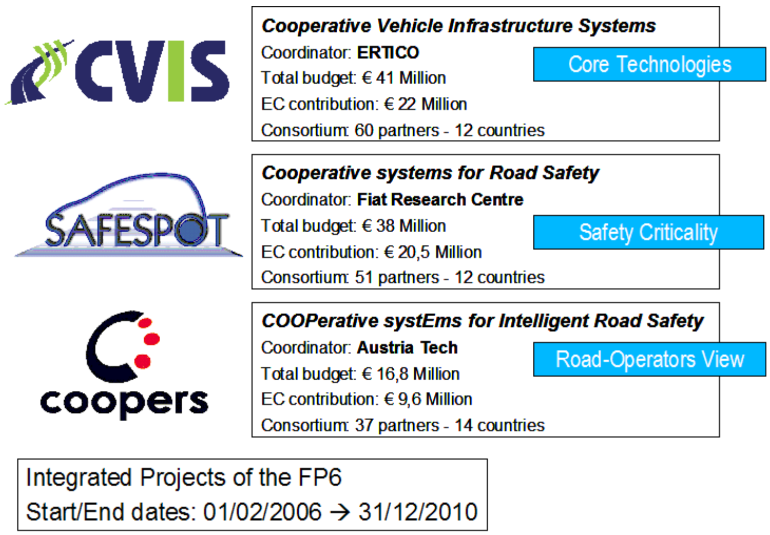

Figure 1: EU FP6 projects on Cooperative systems

Cooperative Vehicle Infrastructure Systems (CVIS)

The goal of the Cooperative Vehicle Infrastructure Systems (CVIS) project is to develop technologies allowing vehicles to communicate with roadside infrastructure and other vehicles, and to share data about the traffic status and the immediate road environment. This network-wide information, when processed and delivered to drivers, will lead to fewer traffic accidents, lower congestion delays, and reduced fuel consumption and pollutant emissions. The project has created a standardised router for vehicle and roadside installation, providing continuous and seamless connectivity using network and "hot-spot" media such as 3G cellular, WLAN, D SRC and infrared. Innovative positioning techniques and software management for cooperative services complete the CVIS platform, which is non-proprietary. The deployment of such technologies promises to provide new services for drivers, road operators and fleet managers: e.g. synchronising vehicles with traffic lights; personalised route guidance, adapted to the time of day or other factors like congestion or roadworks; automatic parking/ delivery zone booking for commercial vehicles in cities and motorway resting areas, etc. The potential barriers to deployment of these systems are also addressed in CVIS: e.g. individuals' data privacy and security must be assured and CVIS proposes suitable safeguards to be built into the systems, namely for anonym sing data collected from equipped vehicles. This four-year initiative, coordinated by ERTICO - ITS Europe, is co-funded by the European Commission and is due to finish this year.

Cooperative vehicles and road infrastructure for road safety (SAFESPOT)

SAFESPOT is working to design cooperative systems for road safety based on vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication. The SAFESPOT project aims to develop and test the technology that will enable such cooperation, devising a "Safety Margin Assistant" that will increase the amount of information available to drivers. By combining quality data from roadside sensors and data sent directly from vehicles in the vicinity, advance knowledge can be gained about potential safety risks, such as an icy patch, fog bank, obstacle or accident on the road ahead (but out of sight). The communication of warnings and advice to approaching vehicles (both directly to onboard units and via roadside signals) will provide extra reaction time that may help prevent an accident. Key challenges of SAFESPOT are:

- The availability of reliable, fast, secure, potentially low cost protocols for local V2V and V2I communication
- Candidate radio technology: IEEE 802.11p
- Need for dedicated frequency band for secure V2V and V2I, avoiding interference with existing consumer links
- Aligned to C2C-C and CALM standardization groups
- The availability of reliable, very accurate, real-time relative positioning
- The availability of real time updateable Local Dynamic Map

The cooperative approach envisages a scenario in which the vehicles and the infrastructure cooperate to perceive potentially dangerous situations "extended in space and time horizon" limited only by the range of the radio communications. The safety «added value» of SAFESPOT is to look for the «combination» of the information from vehicles and from the infrastructure, by identifying and implementing cooperative solutions that will firstly be applied to the critical areas of relevance for these applications, such as the road intersections, for instance, in the urban areas, or other «black spots» in the motorways and other general roads.

COOPERS CO-Operative Systems for Intelligent Road Safety

COOPERS connect vehicles via continuous wireless communications with road infrastructure on motorways, for data exchange relevant for the specific road segment to enhance road safety and enable Co-operative Traffic Management. Following services are involved for drivers: Accident / incident warnings, Roadwork information and lane specific advice, Traffic jam warning and guidance, in-vehicle variable speed limit information and Traffic congestion warning. COOPERS collects, prepares and monitors traffic flows in the Traffic Control Center and provides vehicles and drivers with real time situation based, safety related data and infrastructure status information distributed via dedicated Infrastructure to Vehicle Communication link (I2V). This approach extends the concepts of in-vehicle autonomous systems and vehicle to vehicle communication (V2V) with tactical and strategic traffic information which can only be provided by the infrastructure operator in real time. Direct I2V communication will extend the responsibility and liability of the infrastructure operator compared with today in terms of reliability and accuracy of information to advice drivers/vehicles. Infrastructure operators provide the following services: International seamless service handover with data exchange between operators, enhanced cooperative traffic management based on floating car data, Safety related information for drivers in the vehicle. COOPERS partners have selected, defined and validated in the demonstrations a wide range of communication technologies, from broadcast, DAB, via cell based, GPR S/UMTS, Wimax to short and medium range communication technologies like CALM IR. These technologies have been tested and validated on 4 extensive demonstration sites in the 6 EU countries Italy, Austria, Germany, Netherlands, Belgium and France on public roads from a technical point of view and from the user perspective with the involvement of more than 200 test drivers.

The different focus of the three IP's creates a need for a common basis, since these IP's are complimentary to each other. A common vision to deployment not only benefits the single IP's but also benefits the deployment of the others. Not only is a common vision required but also a common architecture. For this reason, COMeSafety, a Specific Support Action and the Communications Working Group of the eSafety Forum spearhead Europe's efforts to achieve a common Communications Architecture for Co-operative systems (with support of COOPERS, CVIS and SAFESPOT and other projects in the field of cooperative systems), paving the way to interoperability and standardisation and spectrum allocations by identifying the architecture model. ETSI roles' in later stage standardized this effort. A Communications Architecture for Co-operative systems includes the following characteristics: The ITS applications make use of wireless communications

a) Communications between mobile ITS stations (vehicles), and between mobile ITS stations and fixed ITS stations (roadside installations), with single-hops or multiple hops between the source and destination ITS stations.

b) Access to public and private (local) networks including the global Internet.

c) Infrastructure and satellite broadcast.

These projects are focusing on three different categories of applications: "Road Safety", Traffic Efficiency" and "Other Applications". These three categories have different requirements in terms of latency and geographical coverage. The main focuses of these three application areas are:

2 ''Road safety'', local area, low latency, Wireless 5.9 GHz.
3 ''Traffic efficiency'', Medium range and some latency acceptable, support to "Road Safety for long range coverage,
4 "Other applications" or "value added services", medium – long latency accepted, all Wireless media + global network.

1.2 ACTIONS

The 3 IP's selected, defined and validated in the demonstrations a wide range of communication technologies with different requirements in terms of latency. A very crucial topic on which Europe joint its efforts is the realization of a common European architecture for vehicle to vehicle and for vehicle to infrastructure communication, in this task COMeSafety was heavily involved by chairing an architecture task force that is both collecting and consolidating the requirements and defining an architectural framework in direct cooperation with the projects that are working on cooperative systems for road safety and traffic efficiency. The next stage is to define the building blocks: i.e. The functionalities, the operational requirements; the message formats (DATEX); and security issues. All these have to implemented and tested through means of Field operational tests (FOT). The next step is for large consortia to prepare for Field Operational Tests (FOTs) of near-to-market cooperative applications and services across existing or planned cooperative system test sites. The Field operational tests will have to use one or more common technology platforms for vehicles and infrastructure, and following a common FOT and assessment methodology.

2. Interoperability & Standardization factors

2.1 Challenges

Interoperability and Standardization is necessary for cooperative systems deployment that is why interoperability between the 3 projects was tested at various demonstration events in Helmond in May 2009, ITS world Congress in September 2009 and in the current Cooperative Mobility showcase in March 2010. At least three standardization organisations are developing standards for 5.9GHz ITS band where safety critical applications are meant to reside:

- ETSI TC ITS
- ISO TC204 (Intelligent Transport Systems)
  - WG16 CALM (Communications Access for Land Mobiles) (http://www.isotc204wg16.org),
  - WG18, jointly developing standards with CEN TC278 WG16 on cooperative systems
- IEEE 802.11 /p and 1609 WAVE,

Several people working in the CVIS, SAFESPOT, and COOPERS are also following up the standardization activities such as the ETSI TC ITS, ISO TC 204 or IEEE802.11p and are communicating their IP' results to these bodies. The most important results are currently been transferred to the ETSI and CEN, CENELEC standardization mandate process. In support of the policy goals for achieving improved safety on the roads by Intelligent Transport Systems, the European Commission adopted an EC Decision 'on the harmonized use of radio spectrum in the 5 875-5 905 MHz frequency band for safety related applications of Intelligent Transport Systems (ITS)'5. The purpose of this Decision was to harmonize the conditions for the availability and efficient use of the frequency band 5875-

5905 MHz for safety related applications of Intelligent Transport Systems (ITS) in the Community. European standards for Co-operative ITS services are needed to fulfill the requirements behind the legally binding implementation measure of the spectrum Decision for ITS in Europe, and in order to ensure true Community wide interoperability essential parts of the standards would need legal enforcement measures. For this reason, on 16 December 2008, the European Commission published the European Commission Action Plan for the Deployment of Intelligent Transport Systems in Europe. The Action Plan will be accompanied by a Directive providing a framework for the implementation of this ITS Action Plan. The Member States and the Commission will agree on common specifications aimed at ensuring EU-wide coordinated deployment of interoperable ITS.

2.2 Actions

Despite the great effort already performed in this topic, there is significant work to be done for advanced ITS technology to be ready, adopted and widely deployed, being realistic implementations and field operational trials some of the key issues to be further realised. A continued cooperation between the standardization organizations including conformance and interoperability tests and the research and development projects would be a pre-requisite for the successful standardization of Co-operative ITS services. The standardization bodies will need to consider producing standards for the adoption of open in-vehicle architecture for the provision of ITS services and applications, including standard interfaces guaranteeing interoperability/interconnection with infrastructure systems and facilities. Ongoing work on the Mandate to support the development of technical standards and specifications for Intelligent Transport Systems (ITS) within the European Standards Organizations will have to be continued to ensure the deployment and interoperability of Co-operative systems, in particular those operating in the 5 GHz frequency band, within the European Community. Finally, the follower of the ITS Action plan, the new directive will pave the way for synchronous deployment at national level.

3. Liability

3.1 Challenges

The legal aspects of Advanced Driver Assistance Systems (ADAS) have been extensively investigated in the past. A number of Directives have been enacted in order to harmonise the liability legislation in the EU's Internal Market, assuring confidence of citizens in the safety of products and the possibility to claim compensation in case of damages caused by defective products. Product liability is regulated in the Directive 1985/374/EEC, amended by Directive 1999/34/EC, and product safety in Directive 1992/59/EEC, amended by Directive 2001/92/EC. One major element of legislation which currently restricts the functionality of Intelligent Vehicle Systems is the UNECE Convention on Road Traffic ('the Vienna Convention'), signed in November 1968, stipulating that the driver must control his/her vehicle at all times. Cooperative systems are complex systems incorporating many parties, responsibilities and competences. These growing technical interdependencies between vehicles and between vehicles and the infrastructure may lead to system failure;

and there are questions of financial compensation of losses of road users or other third parties which are governed by non-contractual law.

Within the COMeSafety project no in-depth legal analysis by lawyers was performed. The deliverable D.13 summed 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. CVIS and SAFESPOT projects have analyzed the legal aspects of market introduction of both applications/systems/services. They have both analyzed existing studies regarding legal aspects of ADAS and examined and described specific legal issues in relation to SAFESPOT/CVIS-systems. This consideration of legal aspects are for example applicable laws; statutory liability; use of electronic data recorders in civil law process under English law; disclosure; sale of goods and supply of services under English law. On one hand, in SAFESPOT, they have examined the general principles of incident scenarios and a more in depth study of Dutch and English law. For an example, in an incident scenario (SPEEDALERT) the liabilities are different according to the actors involved. SAFESPOT has a strong focus on urban/rural roads for which a large number of infrastructure managers/authorities are responsible (in the Netherlands more than 500). To ensure harmonized interoperability and geographical coverage may call for legal intervention.

On the other hand, in CVIS there is development and analysis of use-cases and it also looks at different Actor liabilities, creating contractual matrices and looking at the law of tort. Moreover, CVIS devise tools to manage liability and draft recommendations for minimising the effects of liability which could create obstacles to deployment. This consideration of tools to manage liabilities includes: model contracts, relevance of insurance, codes of practice, standardisation, certification and validation, alternative dispute resolution, "without prejudice" restoration fund and risk sharing pools. A Contractual Matrix was also drafted to describe the type of contracts that may govern the relation between the different actors, the standard terms we would anticipate characterizing such contracts, as well as some important general statutory constraints to the principle of freedom of contract.

Finally, COOPERS as an information system for traffic information, has analysed various ways to limit the liabilities of the parties involved. Hereby the most promising solution for public and private partners is the introduction of mandatory certified equipment for the correct transmission of traffic information between road infrastructure based road side units and vehicles. The infrastructure operator guarantees the correct generation and transmission of the messages, and the supplier limits his liabilities with the procedure of the equipment certification to normal product liability levels, similar to other products he produces and introduces to the market. The exact range and the requested levels for the certification procedure will need to be defined in accordance with the experiences and results achieved in the demonstration phase of the respective project.

3.2 *Actions*

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. 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. The ITS Action plan and the future Directive will also offer solution the harmonised national legislations on ITS deployment including guidelines in the field of responsibilities and ownership of information. 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. Moreover, there is a need for clear communicate of requirements for service level agreements (SLA) to the legal parties. Revising the Vienna Convention in this respect should be considered in the near future; otherwise the safety potential of many current and emerging technologies and applications is lost, and the liability issue remains problematic.

4. User acceptance

4.1 *Challenges*

Cooperative systems that connect vehicles to one another and to the road will only be successful if it is accepted, implemented and ultimately used by consumers. The user acceptance of the CVIS system was firstly investigated by an internet based questionnaire study which was distributed to 13 Automobile clubs in 12 countries. Approximately 8,000 European Motorists were asked how useful several CVIS applications were. The results from the questionnaire study showed that CVIS applications are generally well accepted by the end user. In general, more than 50% of the Europeans think they are quite or very useful. Willingness to pay is another important aspect to take into account, as numerous applications will contribute to form the CVIS system. Thus the usefulness of the CVIS applications is higher than the willingness to pay for. Nevertheless, around 40% state that they would accept to pay for them, which means that there can be a positive business case in most of the systems. Moreover, users were also asked about data privacy issues. Only 23% of respondents don't mind the systems invading their privacy since they consider the systems very useful. The user acceptance of the CVIS system was also investigated through a driving simulator study, where a small group would actually experience a few of the CVIS systems (rerouting, speed advice with green wave, infotainment applications) in a driving simulator. The results were also positive as they provided high scores on 'usefulness' and ‘satisfying’. During the demonstration / validation phase of CVIS, users (both personal and commercial) will have the opportunity to also test the real life applications at the different test sites and at major congresses (ITS world Congress, Inter traffic event) and provide their feedback in terms of utility, usability and user acceptance.

In addition to consumer surveys, CVIS project investigated the utility, usability and acceptance of cooperative systems for road operators through a survey to more than 200 representatives of European road operators. The survey consisted of questions on the relevance of cooperative systems for topics such as road safety, traffic management and road maintenance, questions on the usefulness and acceptance of nine examples of future applications and questions on the deployment of the systems. To stimulate these developments, a majority of the respondents thought that road operators should play an important role in implementing and using cooperative applications. Regarding the initial investments for cooperative systems, most of the respondents think the public authority has the most important role. Almost all respondents consider cooperation among stakeholders important or even indispensable for the deployment of cooperative systems. Installing systems in cars as standard equipment (instead of optional) is seen as the most useful instrument to promote cooperative systems. Other important instruments are field operational tests and cooperative research. Financial instruments mentioned the most are tax reduction, market package (car plus starting insurance formula), insurance reduction and direct subsidies. Apart from consumer and road operator’s surveys, car manufacturer’s utility survey was performed through 250 relevant manufacturers from several EU countries which have been contacted via an “on-line” survey and 15 “face to face” interviews with relevant car and trucks managers/experts have been performed. Car manufactures think that the stakeholders that are expected to finance the CVIS system are the Public Authority, together with the Road Manager/Operator. As regards how to finance CVIS system introduction, the use of tax money/ governmental subsides seems to be the best solution, followed by own profit/loss responsibility. Most of the respondents think that in order to reach a certain level of CVIS diffusion it would be preferable to follow a double approach, which sums the intervention of the government (with the introduction of common rules and common standards) to a market driven solution

SAFESPOT also performed a user acceptance study as described in the Deliverable D6.6.1. The conclusions of the study are shortly repeated here to give more insight in user acceptance.

- The evaluation made by potential European users regarding SAFESPOT applications is quite positive.
- The most popular SAFESPOT functions are Rear of frontal collision warning (92%) and Pedestrian detection. On-vehicle road signs provision is the less preferred function.

- The majority of them think that the installation of Rear of frontal collision warning and Pedestrian detection should be mandatory, that is coherent with the preferences stated for their usefulness.
- The Rear or frontal collision is considered as the most “worth to pay” function all over Europe. Pedestrian detection is the second “worth to pay” function indicated overall the EU countries.
- As regards to the ways of payment, the majority of respondents would prefer to get SAFESPOT when they buy a car, with the price included in the overall vehicle’s price. If they had to pay to buy the system, most of them would be disposed to pay more than 150 Euro. Among the ones who selected “Pay when I buy a car”, the majority would pay 150- 350 €.
- As regards to the Pay-per-use modality, the respondents are willing to spend less than 100 euro/10.000 km. About the annual fee, the majority would prefer to spend less than 50 euro/year, while the 36.3% would like to spend 50-100 euro/year. Among the few people who selected the monthly fee option the majority would like to spend less then 5 euro/month.
- Beyond the safety applications, the most cited additional functions that the users would like to have on board is Traffic Information.
- About the best way to improve road safety there is a quite similar distribution for the three options: improving driver’s education and road infrastructure together with the introduction of on-vehicle functions to help the driver to prevent accidents. The adoption of enforcement measures was the less preferred option.
- The respondents said they would prefer to be informed about new on-vehicle safety functions thought TV, internet and newspapers channels by Government, Car dealers and automobile clubs.
- Generally there is a relation among the Km driven in the last year and the driving experience and the level of utility attribute to the SAFESPOT functions.

In COOPERS, user acceptance was measured as part of the extensive COOPERS field tests, where randomly selected drivers did test drivers with the COOPERS system in real traffic situations on motorways in Austria, Italy, Germany, the Netherlands and France. In total more than 200 test drivers participated in these field tests (each test procedure lasting for approx. 3 hours, including the filling of a pre- and a post questionnaire, fitting of the measurement equipment such eye tracking and hart rate, a familiarization drive, a drive along the test route with the system and one without the system). The user acceptance measurement was done by means of two questionnaires; one was given to the test drivers before their test driver, measuring their expectations towards the system. The second test drive showed the experience after using the system. In this chapter, the results of the user acceptance measurement of the COOPERS test site in Vomp (Innsbruck, Austria) during January 2010 with 47 test drivers are displayed. All drivers have a principally very positive attitude towards the system. They perceive the COOPERS system to be useful. Especially positive for them is the improved driving safety and the improved information about road conditions. The COOPERS system is a very user-friendly system and the test persons especially liked the easy to use interface. Most of the test drivers would use such a system and recommend it to other people. Data privacy is not a concern in the eyes of these people. Concluding you may say, that the experience of the test drivers outperformed their expectations towards the system. Figure 2 shows the results for the measure **"perceived usefulness"**. It depicts the single questions that were asked to the test drivers and shows the likert-scale, where respondents were asked to rank their answers in a continuum between "strongly agrees" and "strongly disagrees". The figure shows, that the test person had very positive expectations towards the COOPERS system already before they actually experienced it. The figure shows, that the actual COOPERS system experience outperformed the test drivers' expectations: in average testdrivers found the system useful during driving, they found that the system enables to accomplish driving tasks more quickly, and they found that with the system they have improved information about road conditions.

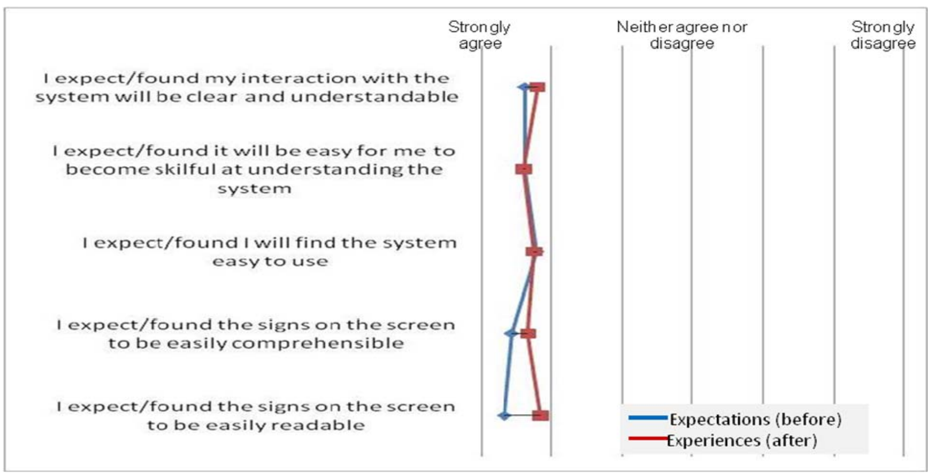

Figure 2: COOPERS perceived usefulness

Overall, the test drivers reacted in a very positive way to the COOPERS system. All major indicators for User Acceptance rank exceptionally high, and are positive in a before/after comparison. Especially the very easy to use interface to the user and the useful COOPERS services seem to have a good impression on end users targeted.

4.2 Actions

With respect to specific actions needed for the user acceptance, more acceptance tests in real-world situations are needed to show how people react on such systems. A Field Operational Test will focus on naturalistic driving: this means having real drivers driving in real driving conditions. Drivers should use their vehicles during their daily routines, data logging systems should work autonomously and the drivers do not receive specific instructions. Drivers should be normal drivers, with no specific training. Systems should be final systems. Initial real user acceptance tests have been performed by COOPERS as described above with significant results. However, more user samples should be involved and more matured use-cases might be trailed in simulator and real tests studies. There is a need to identify realistic research questions and hypothesis and identify and specify the appropriate indicators relevant to core cooperative services for assessing the system performance, the impacts on efficiency, the environment, safety, user acceptance and driving behavior. More important of all, dissemination awareness of the clear benefits to the users and travelers must be apparent at all cases.

5. PRIVACY & SECURITY

5.1 CHALLENGES

ITS applications and services are based on the collection, processing and exchange of a wide variety of data, both from public and private sources, including information on traffic and accidents but also personal data, such as the driving habits and journey patterns of citizens. All these may raise a number of privacy and data protection issues that should be carefully addressed before deployment starts. Cooperative systems must comply with the European Directives relevant to the protection of privacy and data protection: the Directive 95/46/EC on data protection and the Directive 2002/58/EC on privacy and electronic communications. A significant feature has been the work of the Article 29 Personal Data Protection Working Party, set up in accordance with Article 29 of Directive 95/46/EC. The Working Party comprises representatives of the Privacy Commissions/Data Protection Authorities of the Member States and of the European Data Protection Supervisor. The Working Party regularly issues opinions and resolutions on themes relating to privacy and personal data protection. In general, the increasing awareness about the importance of security and privacy aspects in the design of any complex system storing and exchanging data is fully reflected in the presence of specific working groups in all standardization bodies. This applies also in the ITS domain. For example, in the ETSI[1] Technical Committee ITS, a dedicated Working Group (namely ETSI TC ITS WG5) has been appointed to analyze the specific security/privacy issues of the ITS domain based on the any guidelines and standards already established and being increasingly adopted.

There are also a number of EU-funded projects which have or are now looking at privacy and the related issue of security. These include:

GST-SEC which was the initial project that focused on security for telematics applications. In its White Paper, December 2006, it states: "The vision of GST Security (GST SEC) is that future large-scale infrastructure for telematics applications will have to ensure security, privacy and reliability requirements, based on common approaches, models and mechanisms. The deployment and operation of applications and infrastructures for telematics will only be possible if they rely on a proper trust value chain."

CVIS FOAM & DEPN Topic 3 is dealing with authentication and authorisation as a security issue not a data protection or privacy issue. A critical issue for CVIS is the coherence of the

[1] European Telecommunications Standards Institute

data coming from the different sensors but trust is maintained because all entities within the CVIS context detect and locate on multiple levels and location awareness comes with the technical characteristics of correctness of data and performance. To enable secure communications and protect privacy, an Identity Manager is established within CVIS which is responsible for storing and leasing pseudonyms to client applications and privacy is thereby protected. The Identity Manager infrastructure is currently being investigated by the SeVeCom working group.

The SeVeCom (Secure Vehicular Communication) project which aims to provide a full definition and implementation of security requirements for vehicle communications, including authentication, confidentiality and anonymity or the use of pseudonyms.

The Preciosa project deals with data protection entirely and whose goal is to demonstrate that co-operative systems can comply with future privacy regulations using technology to protect location data. It also focuses on privacy of communication and privacy of data storage.

Evita is dealing with vehicle intrusion protection.

5.2 ACTIONS

Upon the principal conclusions of the opinion of European Data Protection Supervisor to the EC Action plan as outlined in a press release of 22 July 2009, was that data protection has been taken into consideration in the proposed legal framework and that it is also put forward as a general condition for the proper deployment of ITS. The Opinion then went on to make the following three recommendations:

"Privacy by design" approach: the EDPS recommends considering privacy and data protection from an early stage of the design of IT'S to define the architecture, operation and management of the systems. Privacy and security requirements should be incorporated within standards, best practices, technical specifications and systems.

clarification of responsibilities: it is crucial to clarify the roles of the different actors involved in ITS in order to identify who will bear the responsibility of ensuring that systems work properly from a data protection perspective (who is the data controller?);

Safeguards for the use of location technologies: appropriate safeguards should be implemented by data controllers providing ITS services so that the use of location technologies is not intrusive from a privacy viewpoint. This should notably require further clarification as to the specific circumstances in which a vehicle will be tracked, strictly limiting the use of location devices to what is necessary for that purpose, and ensuring that location data are not disclosed to unauthorised recipients;

The Opinion from EDPS has, in the CVIS and SAFESPOT context, prompted a series of meetings between the eSecurity Working Group and the Working Group 29 which is an independent European working group dealing with personal data protection and privacy. At the meetings of the eSecurity and Article 29 Working Groups, a number of use cases are presented and examined from the privacy perspective. The use cases under present consideration relate to:

- Safety Applications, relating to Speed Alert (from the SAFESPOT Project)
- Speed Profiles for Traffic Light Management
- Pay-as-you-drive/road pricing
- Parking services and hotel reservations

Given the date by which this paper is to be completed, it is not possible to report on the outcome of these consultations but it is clear that privacy issues are a high concern in the development of cooperative applications.

6. Business modelling & organisation

6.1 Challenges

In principle the socio-economic approach of Cost Benefit Analysis takes the cost and benefits of all stakeholders in an economy into account. The negative effect of one stakeholder can be a positive effect for another. So for the society as a whole, the positive and negative effects are summed but the distribution between the various stakeholders can greatly affect the way that an ITS service is perceived. Governments are one important stakeholder; private sector decision makers may have different requirements in terms of ITS performance than those that are required by other societal groups. Different stakeholders have different perspectives. The authorities for example must consider how to improve the overall goals they want to achieve, which could be of a general nature as reduced environmental impact from road transport, improved road safety, more efficient use of the road transport system and eventually also regional development goals. The development of the bundle services should therefore be performed with respect to different perspectives:

- The government perspective is to support transport policy goals.
- The road users' perspectives are efficiency and safety.
- The industrial perspective is to build effective logistics systems.

To be able to conduct the economic validation of the deployment of the CVIS infrastructure the services provided based on this infrastructure needed to be included. To be able to evaluate the economic potential of both the infrastructure and the services a two level analysis was conducted. The cost model is based on the CVIS infrastructure. Within the infrastructure there are four major cost objects distinguished. First the On-Board Unit (OBU), second the Road-Site Unit (RSU), third the Traffic and Control Centre (TCC) and final the Communication. To determine the costs a Life Cycle Costing (LCC) approach is used where the cost to purchase the object, the costs to implement the object and the costs to maintain the object are determined and projected over the life cycle of the CVIS infrastructure over 25 years. The benefit rationale is build around the cost reducing effects of services. The cost reducing effects are grouped in the benefit categories safety, efficiency, vehicle operation and environment. Evaluating the benefit potential it became remarkable that the majority of the benefits can be earned on the major roads and especially in the benefit category safety.

The CVIS business models would depend on via:

- Public (safety and efficiency policy driven) with services like: car sharing, eco-driving, find parking and charging station of electronic vehicles, access management, real time route planning and rerouting, intersection & priority applications
- Commercial (freight and fleet services) with services like: access control / loading zone & parking booking / (electronic tolling as balancing factor)
- Personal (traffic info services) with services like: Floating Car Data collection, real-time traffic & road status, incidents, congestion avoidance through dynamic navigation (on-board) and route recommendation (off-board)

These scenarios are not exclusive and it is likely that all three will be pursued by various actors of the cooperative chain at the same time. All the three scenarios (public, private and commercial) have the same road network scope and relating cost projection. The differences in the scenarios occur in influence of the services applied on benefit projection. In the analysis of 3 scenarios it became evident that the projected benefits of both the personal and commercial scenario are clearly not covering the projected costs because of the non involvement of the public party. Only the public scenario showed a positive cash flow. The solution was to bundle the services in a personal, commercial and public way with the services in scope. Those scenario's that contain additional services which addresses safety aspects except efficiency ones are the only scenarios that can be profitable based on the costs involved to build the necessary infrastructure.

COOPERS conducted a cost/benefit analysis during the early stages of the project, subject to an update at project end. Similar to CVIS methodology, a case study was performed to assign concrete values to the cost and benefit issues. However, the evaluation of the impacts of intelligent transportation system is related to a number of methodological problems. Several influencing factors, like unpredictable future driving behaviours or the interaction between different safety technologies, make the evaluation of safety impacts of ITS difficult. In addition, little or no application history of future technologies complicates an assessment of future impacts. The benefits of the COOPERS system was divided in Socio-economic benefits as well as Macro-economic benefits. The main socio-economic effects of COOPERS can be categorized into the dimensions traffic safety and traffic efficiency. These safety-critical (reduction of accidents and severity of accidents and subsequently reduction of congestion and enhancement of traffic flow) and non-safety-critical effects (efficiency, such as homogenization of traffic flow, transport organization, and driving behavior) have an impact on the main factors time, energy, accidents, environment and on the costs related to these factors. The safety and non-safety impacts of intelligent transportation systems affect economic benefits that mainly consist of cost savings. These cost savings are connected to the reduction of the number and severity of accidents, the number and duration of congestions, the reduction of time losses, of emissions and of vehicle operating costs. Improved road safety and efficiency can lead to increased economic productivity of a country. Time losses due to traffic delays can be avoided and thus more time can be dedicated to productive activities (i.e. both, leisure and working time). In addition different industries can profit from the deployment of ITS (for example the insurance industry, equipment manufacturers etc.). Further macro-economic benefits described underneath originate from the development and production of ITS.

- Production effects
- Employment effects
- Income effects
- Financial sustainability
- Practicability and public acceptability

As with CVIS project, the cost of the COOPERS system was divided into investment costs, maintenance costs and operation costs. The category of investment costs includes the production costs for the equipment manufacturers and the sales prices for the user of such systems. In general the sales prices are higher than the production costs because of profit margins. The investment costs in COOPERS include costs for the On-Board System (PC, Gateways, and Cabeling), Software costs and costs for the Roadside System (PC, Gateways, and Cabeling). Different figures taking into account market maturity were considered (costs for prototyping, early deployment and serial production). The maintenance costs of ITS depend on the complexity and robustness of such systems. The maintenance costs include the estimated costs for keeping the new software and hardware up and running. The best sources for maintenance cost estimations are people who have been using the item in question for at least several months in essentially the same environment as you intend to use it. However, these costs will play a minor role in the overall COOPERS cost structure. Operating costs include staff training as the primary component. Both staff turnover and the release of new versions of the software, as well as of the hardware, add to this cost. The cost of staff training reflects the relative user-friendliness of the different systems. Additional components of operating costs are energy costs that are related to the use of such systems. [RD 30] Further, communication costs form a part of the operating costs of a COOPERS system. Just as the maintenance costs of such a system, they will play a minor role.

SAFESPOT made a socio-economic assessment which compares two SAFESPOT cooperative system bundles based on technically-specified safety applications. The comparison is done for two extremes in the area of possible solutions for cooperative systems: the Vehicle to-Vehicle concept (V2V) on the one side, and the Vehicle-to-Infrastructure concept (V2I) on the other side. The core of the assessment methodology is a cost-benefit analysis (CBA) using cost-unit rates for possible safety and traffic effects of the SAFESPOT bundle to prove the profitability of the system from a society point of view. To complete the assessment, a stakeholder analysis checking the profitability of the cooperative systems from the point of view of vehicle drivers, road operators and public authorities was undertaken. The safety impact analysis showed considerable safety effects resulting in about 7.1 % less fatalities for the V2V case, and about 8.9 % for the V2I case, assuming a 100 %-penetration rate of cooperative systems into the vehicle fleet. The figures for the injured were quite similar. Benefit-cost ratios were derived using the safety effects, the accident trend data, cost estimations, and forecasted market penetration rates for the SAFESPOT systems. For the

V2V case, benefit-cost ratios ranging from 1.0 to 1.1 were found for fleet penetration rates ranging from 6.1 % to 8.7 % in 2020. The fleet penetration rates have been estimated by experts during a market assessment assuming that the deployment in new vehicles starts in the year 2015. From a society point of view, the benefit-cost ratios calculated for the V2V based system are acceptable. In contrast to the V2V case, the benefit-cost ratios calculated for the V2I based SAFESPOT system are clearly lower than 1. The calculation is based on fleet penetration rates ranging from 5.4 % to 9.5 % in 2020, and on an infrastructure equipment rate of 50 %. Scenarios with far lower infrastructure equipment rate have been also analyzed, but show similar results. This indicates that the V2I based SAFESPOT system is not efficient under the given assumptions from a society point of view. The low benefit-cost ratio of the V2I system is mainly caused by the high costs resulting from a large-scale equipment of the infrastructure. However, the scenario analysis reveals that the profitability of the V2I system from a society point of view could be increased, if the equipment of infrastructure is done on a smaller scale concentrating on accident black spots. The SAFESPOT system is only working with a short range communication (with a maximum coverage of 1500 m). This has the consequence that to get the infrastructure sufficiently equipped, a large number of roadside units RSU) is necessary for deployment which results in very high infrastructure costs of the V2I bundle.

6.2 ACTIONS

Since cooperative systems are not on the market or installed only to a very small scale in the vehicle fleet we have to expect economies of scale in costs of the applications. The acceptance by the user is a critical criterion for a success full implementation. Also the risks involved with the planning of the deployment of the infrastructure and the services and the planning of the business around the services itself is evaluated as critical for a success full implementation. The three IP's took into account several hypotheses when performing the cost benefit analysis. The approaches succeeded to meet some restrictions on the availability of data with regard to technical specification of applications, test site results, and cost data. Moreover, some adaptations and further development of the methodologies were done because of the special requirements of the projects. These developments particularly concerned the assessment of system bundles in contrast to single applications.

The projects results offered balancing factors to overcome any particular barriers in terms to costs. In CVIS, road tolling can be used as balance item in case of a deficit. Road tolling has next to the effect of generating income from the tolling itself a beneficial effect on congestion, fuel reduction and pollution. In case of adding tolling to the existing services in a certain scenario it is important to know that these beneficial effects will possibly evaporate as a result substitution of services. In case of enough public interest the public authorities could decide to claim the costs via road tolling. Based on the outcome of the analysis a single personal or commercially scenario with a limited public interest will not be beneficial enough to cover the costs involved. This leads to the conclusion that private and commercial benefits only could be achieved when the costs are shared with the public party. The public authorities instead will only be interested if the public interest is severed. Another solution proposed by deployment business models scenarios of COOPERS is already available with low penetration rates possible. COOPERS enables Infrastructure Operators the deployment of co-operative services on hot spots as addition to existing infrastructure. The cost benefit analysis has shown that the COOPERS service shows a clear benefit in terms of related costs for the infrastructure operators compared to investing in "traditional" infrastructure such as overhead gantries.

From the SAFESPOT benefit-cost results and the stakeholder analysis it can be expected, that it seems more successful to start the deployment with a V2V solution than with a V2I solution. On the other hand, if public authorities opt for a V2I based solution they can stimulate the fleet penetration by providing the infrastructure equipment thus relieving the financial burden for the private user. This effect is indicated by the lower critical mileage of the V2I based solution. The economic assessment provides some indication for deployment strategies of combining V2V and V2I based cooperative systems. Considering the V2V based solution as the starting point for the deployment, it seems that added value in terms of increased safety benefits can be achieved, if in addition to a V2V based solution a V2I based solution is implemented. This requires a "smart" equipment of the infrastructure concentrating on a limited number of black spots with high accident numbers. A balancing factor for SAFESPOT is it was also shown for public authorities would receive a considerable amount of additional VAT earnings based on equipping of vehicles and infrastructure with the SAFESPOT system. The VAT earnings depend on the relevant scenario and penetration rate and range between 181 million EURO for a penetration rate of 5 % and 395 million EURO for a penetration rate of 20 %. This amount of money may be used for fiscal-neutral supporting actions to increase the attractiveness of cooperative systems. Moreover, for the future SAFESPOT made an extra assessment of the "additional" component costs that are needed to implement the SAFESPOT functionality. E.g. by 2020 high precision GNSS (GPS and Galileo) will be available; also the cost for displaying the SAFESPOT warnings is minimal since all vehicles will have displays for showing warnings. Specific for SAFESPOT are the sensors that are needed to provide the functionality (e.g. radar etc.)

As an action point for the future is to Establish Organization and develop Business Models through continued close cooperation with key stakeholders in a Public-Private environment where real benefits of cooperative systems for all stakeholders will be validated through means of Field operational tests. Moreover a strong commitment of European players beyond the project boarders assures that there is a need for such kind of co-operative systems and also that infrastructure operators are willing to make the necessary up-front investments. This leads to the conclusion that a public and private participation (PPP) will be needed to implement these services and the necessary infrastructure. In the evaluation of the results is important to realize that the maximum benefit potential to be achieved depends on the progression of the penetration. The earning back of the fixed costs is maximized when there is a high penetration rate from the beginning of projection period. With a large share of fixed costs this could lead to a situation where the progression of the penetration is determining if the project will be profitable or not.

7. Political

7.1 Challenges

Every year, approximately 150,000 pedestrians are injured and 6,000 killed EU-wide in traffic accidents. The growth of congestion and its undesirable economic, environmental and social effects represents a major concern for transport policy makers. By their nature cooperative transport systems involve many different stakeholders. They also affect many policy areas. The policy may be based on giving more priority to certain groups within the traffic stream, e.g. public transport vehicles and other high-occupancy vehicles. Depending on this strategy network operators may adopt a highly assertive approach, where the infrastructure system takes a significant amount of control, e.g. limits maximum speeds, slows down vehicles on approaches to intersections, or limit the use of cooperative techniques to improve the information available to drivers to support “better” decision-making.

In an attempt to explore the most important impacts from CVIS for policy delivery, an interactive session was organized in cooperation with POLIS (network of cities and regions from across Europe). In this session experts in the field of transport policy and cooperative systems from local, regional and national authorities verified and added items to lists of policy impacts from the broad inventory, based on the literature review. The experts selected and ranked new opportunities for policy delivery related to cooperative systems, as well as potential negative effects that will need attention and expected obstacles for the deployment. The interactive session showed that CVIS provides new opportunities for policy delivery on the whole chain of travelling, starting with the decision of an individual to make a trip, followed by the choice of the moment of travelling, the choice of the mode of transport, the route choice, the reactions on circumstances during the trip to avoid accidents and the reporting of incidents. The participants in the session think the impacts of CVIS on the guidance of traffic on the road network could be substantial, including the impacts of giving priority to public transport and freight transport. This could lead to a more optimal use of the road network according to policy plans, which – to a certain extend – can go hand in hand with improving road safety and reducing negative environmental impacts. Nevertheless also potential conflicts within and between certain policies areas can be derived from the session. Participants in the session see a conflict, if in CVIS there would be too much emphasis on private cars. Instead CVIS should contribute to a well-balanced overall transport policy with attention for all modes of transport. Other potential conflicts mentioned in the session concern the overall effects on road safety and privacy protection.

In order to translate the findings from the literature review and the interactive session into practical policy issues for the deployment of CVIS, fifteen key-policy makers and advisors from ten different EU countries were interviewed (face to face). The interviews and questionnaire show that from the policy perspective the development of CVIS is still in a very early stage. The development of CVIS could go according to an iterative process of deepening (getting more experience by doing tests), broadening (exchanging knowledge) and scaling up (to a level of performance suited to serve national and European policy goals). Interviewees think that in this process a roadmap at the EU-level could be very useful. At the national level a big challenge is to get CVIS on the political agenda. The interviewees indicate that to further develop CVIS, initially many Field Operational Tests

(FOT's) should be carried out. The final step is to scale up to a level of performance suited to serve national and European goals. In this process the interviewees advise to follow a so-called target oriented approach, using a roadmap at the EU-level for the deployment of CVIS. This roadmap should encourage processes of searching, learning and experimenting as well as stimulating a mindset change among policy-makers. It should be based on policy priorities and political considerations and contain a clear timeline. To achieve sufficient penetration for CVIS to make significant impact, it is essential to ensure – in due course – interoperability among countries.

7.2 ACTIONS

There is a need for better cooperation among the European Commission and its initiatives the member states and the industry. On a higher level, policy support through the Intelligent Car and the eSafety Forum and its Working Groups (with Socio-economic Impact studies) and the ITS action plan need to be provided. In general, further research should be undertaken on the level of regulatory and legal harmonization that currently exists in Member States and how it may be improved, particularly in the Member States in which initial deployment is planned.

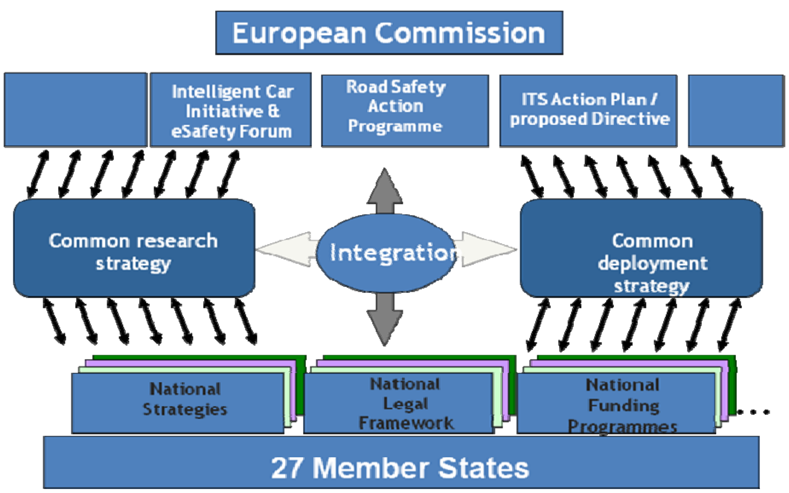

Figure 3: Cooperative systems and policy

Moreover, an effective cooperation is needed between public and private stakeholders, a careful handling of privacy issues and a suitable government strategy. A viable business case will help to put cooperative systems on the political agendas and stimulate investments. A suitable Public-Private-Partnership (PPP) is crucial for this cooperation. Governments (at all levels) could participate in international platforms or in other experiments or FOT's throughout Europe to gain insight in miscellaneous "best-practices", not only regarding test methods and techniques, but also regarding the policy impacts. On the other hand they should stimulate the participation of other authorities in their own tests and spread the insights they gain to enhance the cooperative systems introduction.

8. DEPLOYMENT CHALLENGES

In this last section, the 3 IP's will try to map the three deployment roadmaps, taking into account all the different deployment challenges that were discussed in the previous sections. CVIS will focus on a deployment model framework whilst SAFESPOT and COOPERS will focus on a scenario approach for explaining the different deployment paths for cooperative systems. Let's see the different approaches:

In Figure 4, the overall deployment model and framework for CVIS covers the main elements and stakeholders needed for a working CVIS system equally distributed over the stakeholders of costs, benefits, risks, liabilities and control over policy decisions. Starting from the external influences such as public demand for safe and efficient traffic of people and goods, to commercial transport needs to the individual need for personal mobility. In the model these are identified as external influences driving the overall need for the cooperative services. The CVIS services are the link between the users' needs and the network that enables the services. It will be of key importance for successful deployment to identify services bundles combining cooperative services with other network-enabled services. The core technology of the system is then modelled as separating the road-side equipment from the vehicle equipment, connected through the CVIS-system. So, the deployment of CVIS is thus described from three different angles of approach, as three scenarios as described: one commercial, one personal and one public. In Figure 4, for each of the focus areas mentioned in the deployment model, there are issues and drivers. The deployment areas have been scrutinized and for each area the main drivers has been identified. The actors are the same in the three scenarios:

- Others, i.e. authorities and COPA (Cooperative Open Platform Alliance)
- Cooperative Service User
- Cooperative Service Provider
- Cooperative vehicles and infrastructures provider

Critical issues that only could be resolved through CVIS deployment are described as well and also potential showstoppers for CVIS deployment. The critical issues that have to be addressed can be divided in the following categories:

- Law and regulations constraints: technology improvement runs at a very high speed but laws and regulations are "updated" very slowly; in many cases technologies enables new services but regulations and law forbid their deployment and launch.
- Technological maturity: the service has to be based on mature technologies easily available on market.
- Economic (operating costs): operating costs and customer service costs are key elements for a successful deployment.
- Infrastructure deployment: a successful and robust deployment of the infrastructure is technological basis for Service deployment.

- "Ecosystem" creation: all stakeholders' needs and expectations have to be taken into account to create an "ecosystem" ready to accept and accelerate the deployment of CVIS services.

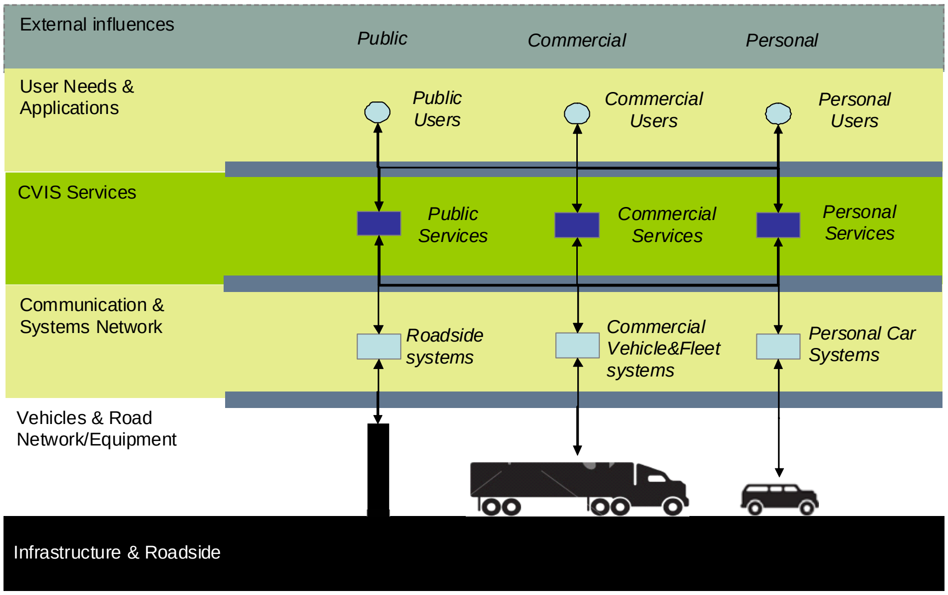

Figure 4: CVIS deployment model

In Figure 9, the aggregated deployment roadmap is shown, taking into account the different development paths for the different technical elements and stakeholders. It is focusing on the activities or development that needs to be taken in order to fulfill the vision of a cooperative vehicle-infrastructure system. The roadmap is the unified roadmap from all development paths in the development model, including technical as well as non-technical development. In the short term, to test in real use technically mature selected common cooperative applications developed in the CVIS project and related projects by means of Field Operational Tests (FOT).In the midterm stage, it is targeted that the first set of mature applications (both safety and efficiency) are realized and fully deployed. The deployment of Cooperative Systems will follow "snowball-effect". The Cooperative Systems deployment will start in limited fleets, e.g. taxi, trucks, public transport etc. in order to be spread to other users afterwards. In the longer term, full deployment of services and infrastructure will be supported.

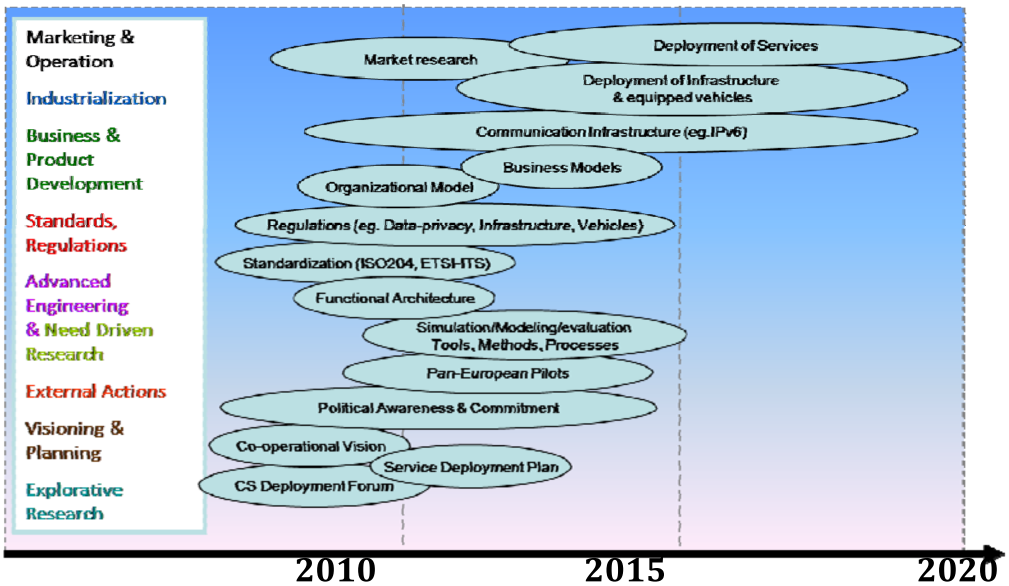

Figure 5: CVIS aggregated deployment roadmap

Whilst the SAFESPOT project has made significant inroads towards eliminating or reducing the effect of potential deployment barriers, uncertainty remains surrounding, for example, the configuration of the system; whether it will work with low-level market penetration; liability exposure; and the robustness of the business models. To try to overcome this uncertainty and to gain greater insight into deployment of co-operative systems, exploratory scenarios were developed which identified deployment challenges and assisted in the formulation of recommendations. Eight basic scenarios were developed, three of which formed the basis of interviews and workshops with public and private stakeholders. The challenges that were identified were validated with experts on co-operative systems from the SAFESPOT and CVIS projects.

Scenario analysis proved a useful tool involving a number of steps. The first step is to define the current situation where cars are equipped with navigation systems, speed alert, reservation and payment systems which have become popular with commercial road operators and also legally obliged road user charging. The process moves through the definition of deployment factors which involves reference to previous work on risk analysis to determine what deployment factors are influenced by each risk, resulting in the generation of eighteen scalable factors for example organization, where the scalable factor is organizational complexity. The most important aspects of the deployment factors for the scenario definitions related to their level of influence and level of uncertainty. The scenario model itself, the specification of which is the third step in the process, could be described as an influence model, underpinning the ability to explain the logic in the developments presented in the scenarios and also the values assigned for influence and uncertainty of the deployment factors. Scenarios are defined along three dimensions (Figure 6: SAFESPOT scenarios and scenario dimensions):

(i) the technical configuration (i.e. V2V or V2I);
(ii) the organizations that will take the lead in the particular scenario (either a public or private lead); and
(iii) The functional scope of the system (safety functionality only or multi-service).

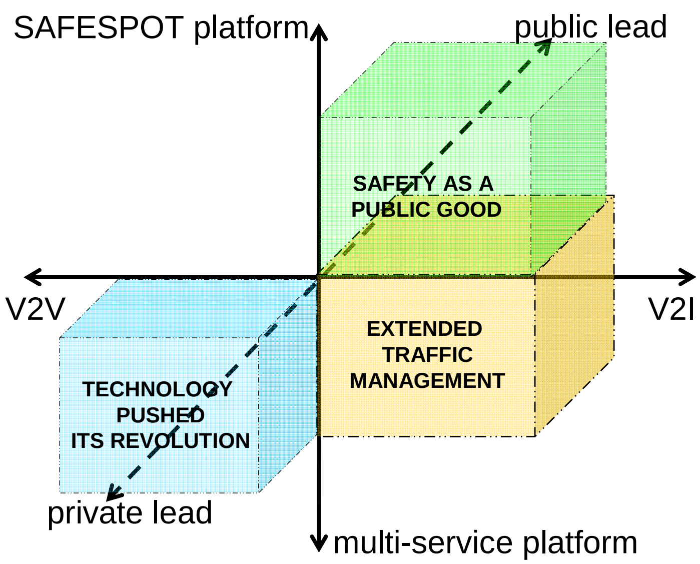

Figure 6: SAFESPOT scenarios and scenario dimensions

Each scenario describes a number of variables, for example, applications/functionality; technical configuration; market penetration; standardization; business model; organizational architecture; and the societal cost and benefits. Each scenario is described in terms of its final situation – what the situation at the end of the scenario will be – and the deployment path to reach that goal.

The three favored scenarios for SAFESPOT were (Figure 6: SAFESPOT scenarios and scenario dimensions):

(i) technology pushed ITS revolution;
(ii) safety as a public good; and
(iii) Extended traffic management.

The report describes the assumptions used for each scenario; the expected situation in 2020; deployment challenges; and recommended actions. The research into scenarios was intense and provided a useful insight into deployment challenges. Allied to this work, the question as to which co-operative vehicle system would be deployed and when. The roadmap (Figure 7: SAFESPOT deployment roadmap) that evolved determined that the different SAFESPOT applications would be deployed only when their functional requirements were matched with available platform which suggested that the co-operative safety warning system would be provided first on nomadic devices using existing cellular networks for communication (e.g. Local Hazard & Incident Warning), followed by time critical warning systems (e.g. Intersection Safety Warning) on factory fit in-car systems based on short range communication.

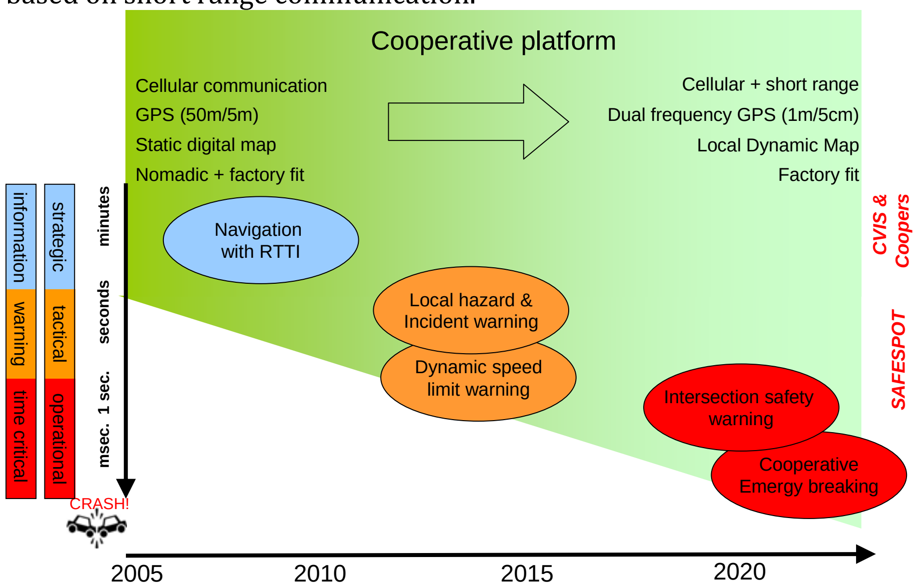

Figure 7: SAFESPOT deployment roadmap

The conclusions reached in SAFESPOT identify a number of challenges, each with a proposed solution. A major challenge is to reach critical mass or at least to reach sufficient penetration of equipped vehicles, deemed to be 5 to 10%, and equipped infrastructure to provide safety services. In the absence of equipped infrastructure, less information would be available and there would be less communication as between vehicles, as a result of the low level of penetration. Equipped infrastructure would ensure that the services would be available for a small number of equipped vehicles. Alternatively, use of existing penetration of nomadic devices and the existing long range cellular infrastructure would provide an alternative solution for non-critical safety applications. The deployment path should be walked one step at a time to avoid taking unnecessary risks like fully equipping intelligent roadside infrastructure which would need huge investment. One small step recommended is to provide non-critical co-operative safety functionality on the currently available long range cellular communications networks, followed by a challenging step to make a transition from an in-car platform with a single (cellullar) communication technology towards a platform with different communication technologies to realise the full potential of co-operative safety systems.

Standardization is a key precursor to a European market. In order to develop a flexible platform for co-operative safety systems on a European scale, a range of interfaces have to be standardized including as between safety application and communication network; as between one application and another (scenario exchange); and as between intelligent roadside infrastructure and in-car safety applications. All stakeholders need a positive business case in all deployment phases and this is a huge challenge. It is clear is that the level of uncertainty needs to be reduced and initiating field operational tests is an important step in bringing greater certainty. “Co-operative” has been a key and much-used word throughout the SAFESPOT project and co-operation of stakeholders is what is now called for, to realize successful deployment. Creation of a decision-making process or forum to provide the necessary structure for cooperation is urgently required. The evolution of a process manager role in the guise of “Mr Co-operative Safety Systems” could provide an answer in the same way federal agencies made and implemented policy decisions which shaped the Internet of today.

In the course of the COOPERS project deployment scenarios where also developed. These scenarios aim at showing which extreme situations can be possible in the course of the deployment of results of the COOPERS project. Further, the scenarios described can be differentiated from each other quite well, as they show rather extreme cases. These extremes were derived by employing two major variables; nevertheless it should be kept in mind that a broad variety of influencing characteristics of our society play a major role in this respect. In the course of the field research for the underlying document various expert interviews took place, involving different roles and partners in a potential telematics value chain. These expert interviews as well as discussions with the COOPERS project partners and amongst the experts of the COOPERS deployment team were the basis for developing the scenario analysis presented below. The first step in scenario analysis is defining the scope of the planning. One needs to consider how far into the future the analysis can usefully extend. The following figure shows the likely time horizon for the deployment of COOPERS services.

1. In the course of the COOPERS research project (2006-2010), the COOPERS services are in a prototyping stage.

2. Then, during further projects and initiatives early deployment of the COOPERS services can be realized (2010 – 2015). This can be done by means of field operational tests, extension of testing to more regions, etc.

3. After successful testing phases and the involvement of various stakeholders in the value chain, serial production or mass production can start. This will probably take place from 2015 onwards.

The following figure illustrates the three stages of COOPER’s deployment described above.

Figure 8: Scope of COOPERS scenario analysis planning

One simple and widely adopted approach to generating interesting scenarios is to cross two different sets of uncertain variables. The combination of high and low uncertainties in each of the two variables leads to four distinct scenarios. In the context of the COOPERS environment, two main sets of uncertain factors have been identified. These sets have been set out in an internal workshop and were validated and refined in the course of various expert interviews. These sets are:

- Policy (European-wide and national), including regulations and standardization activities. Policy considerations include a regulation to have all new cars equipped with some kind of platform, where different services can be run. Such a forced implementation of platforms in every new car could for example occur in connection with electronic fee collection. Policy could also prompt infrastructure operators to make a certain equipment of the infrastructure mandatory which enables COOPERS services (i.e. the implementation of a traffic control centre, communication technologies, etc.). By and large, this factor is beyond the influence of the COOPERS project team.

- User Benefits, user Acceptance, Marketing Activities. These are factors that can be influenced by the COOPERS project team. This set of uncertain factors also includes the capability of the driver itself (individual driver information absorption capacity), the quality of the service delivered by COOPERS, activities of competing initiatives such as e-call, Tom Tom, Teleatlas, etc. and the initiatives of infrastructure operators (Core question: Will the necessary roadside infrastructure be provided?).

In addition to the main influencing characteristics described above (policy and user benefits), there are various other variables that will have an impact on the market introduction of a COOPERS service, and more general on road safety and road efficiency in the future. Because of the scope of this white paper these variables are not described here. Due to the focus of the COOPERS system on I2V and V2I communication, not only adoption and penetration rates of vehicle users have to be taken into account. A major part for enabling a COOPERS service lies in the hand of the Infrastructure operators. Motorways have to be equipped with dedicated infrastructure, and a traffic control centre is required to enable COOPERS services.

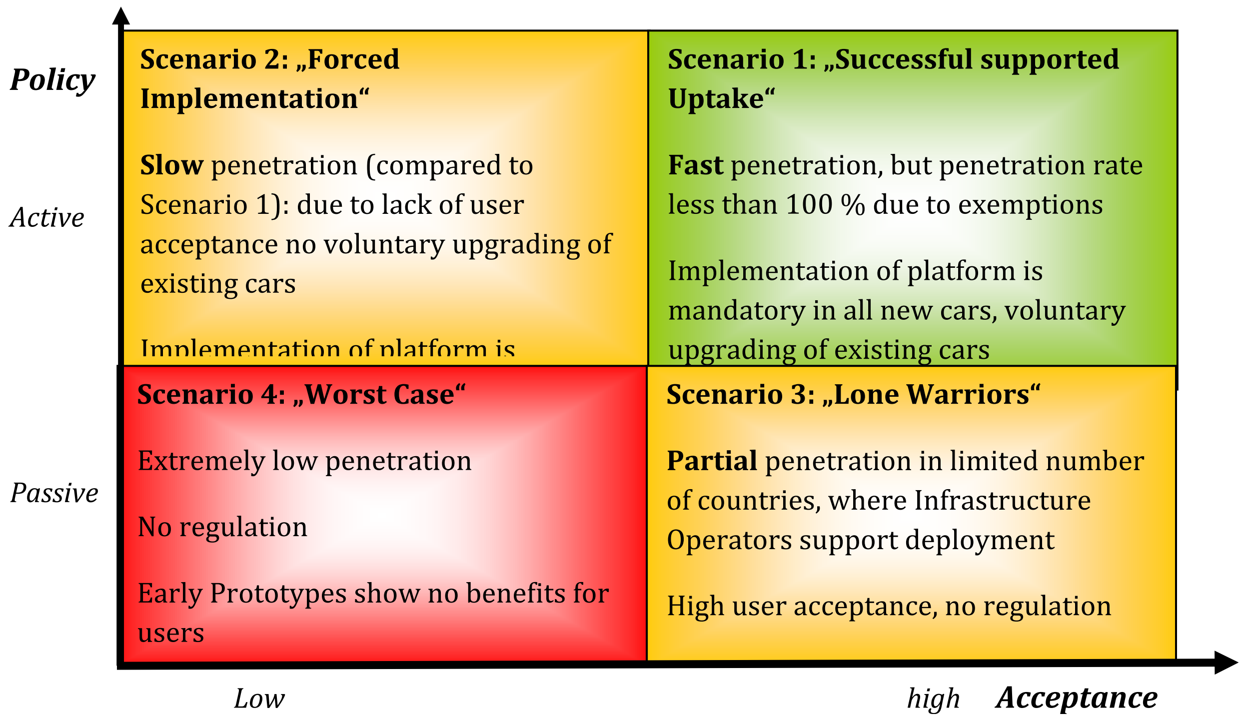

Figure 9: COOPERS market deployment scenarios

8.1 ACTIONS

To sum up, at the high level, the Standardisation bodies (CEN, CENELEC, and ETSI) will have to develop standards in order to ensure deployment and interoperability of co-operative systems and services. This includes inter-vehicle communications (V2V), vehicle to infrastructure and infrastructure to vehicle communications (I2V) and infrastructure to infrastructure communications (I2I) and in particular those operating in the 5.9 GHz frequency band. Proposals should take into account the new mandate on co-operative systems. Moreover, the standardization bodies will need to consider producing standards for the adoption of open in-vehicle architecture for the provision of ITS services and applications, including standard interfaces guaranteeing interoperability/interconnection with infrastructure systems and facilities. This will follow-up the progress in this area and to address any standardisation requirements stemming from this action, taking into account the results of previous activities (e.g., the research project GST, CVIS, SAFESPOT, COOPERS, PREDRIVE C2X and the eSafety Working Group on SOA). This will be streamlined with the ITS Framework Architecture of the existing standardisation activities (especially those on Communication Architecture), within the context of the multi-modal European ITS Framework Architecture proposed by the ITS Action Plan. The follower of the ITS Action plan, the new directive will pave the way for synchronous deployment thus ensuring privacy, security and liability issues at national level.

For long-term deployment the establishment of a deployment plan, together with a long term research and innovation strategy for Cooperative Systems will be necessary. It will also be needed to develop new business models and concepts to stimulate business innovation via proven Field Operational Tests. Potential objectives with future field operational trials would be to carry out a programme of large-scale field operational trials (FOTs) of near market cooperative services, building on results of and linking together existing cooperative system infrastructure & development projects across Europe. The purpose would be to validate a number of core cooperative services & technologies, to measure their impacts and try out organisational and business models before full-scale deployment. To sum up, further research and development will be needed in the longer term to;

- monitor ongoing deployment and study users in FOTs
- analyse effects in the transport system overall
- build new areas of competences
- develop processes for co-user services development
- develop innovative services together with users and stakeholders
- develop new technology and sub-systems for the communication network
- develop new user interface systems

However, the starting point for the deployment work is to develop early a co-operational vision for how a future cooperative system actually will be. This will require that the cooperative community develops a shared vision where the basic elements are identified and the main obstacles for deployment can be handled efficiently as proposed by the 3 in study IP's.

Since deployment of cooperative systems demands cross stakeholder cooperation both from the public and private sector some kind of a "cooperative systems alliance" needs to be established in the shorter term. To meet this need a group of CVIS partners are proposing the creation of a Cooperative ITS - Open Platform Alliance which, after CVIS, would be the home for future discussions amongst the concerned stakeholder groups. In addition, it would also ensure the continuation of operational agreements and platform maintenance, enhancement and promotion. An over-riding goal is to ensure interoperability between future implementations of CVIS results and coherence in any follow-up R&D and commercial activities. This ''alliance'' outline also matches to a large extent the proposed arenas as meant in the SAFESPOT deliverable D6.4.4 Preliminary recommendations dealing with risks and legal aspects. Some of the SAFESPOT partners are also sharing the same vision. In general the main tasks for this alliance will be to foster the dialogue between the main stakeholders and drive critical issues of common interest. One key item is to develop the co-operational vision and follow-up on the implementation of cooperative systems throughout Europe. It will also be important to follow-up on the development in North America and in Asia. The Alliance is intended to be used to enable future deployment of Cooperative Systems and services to create a structured dialogue in the following areas;

- Cooperative Users: focus on the needs and requirements from a user's perspective, liabilities, business cases, operational models etc.
- Test sites: focus on pushing the development from demonstration to deployment by building on the current tests-sites
- Application Developers: focus on harmonised development of applications that enable pan-European deployment of applications, through the different test-sites. Interoperability is of key concern.
- Core technologies: the enabling technologies for communication, standardisation, protocols, APIs etc.

This alliance would not be limited to a number of stakeholders but will be extended to a larger audience of the cooperative systems's world.

REFERENCES

[1] 'SEISS Final Report: Exploratory Study on the Potential Socio-Economic Impact of the Introduction of Intelligent Safety Systems in Road Vehicles'. 2007http://ec.europa.eu/information_society/activities/esafety/doc/call_4/final_seiss.pdf.

[3] TNO: 'E-Impact: Socio-Economic impact assessment of stand-alone and co-operative intelligent vehicle safety systems (IVSS) in Europe. Del3. '2007.

[4] 'Response2: Methods for Risk-Benefit -Analysis of ADAS: Micro Perspective and Macroscopic socio-economic Evaluation. Del 2.' 2004http://response.adase2.net/.

[5] Group, T.R.: 'DIATS: Deployment of interurban ATT test scenarios Deliverable 17: Evaluation of ATT System-Scenario Deployment Options'. 1999http://www.trg.soton.ac.uk/diats/D17.pdf.

[6] Fuchs, S.: 'Organizational Adoption Models for Early ASP Technology Stages. Adoption and Diffusion of Application Service Providing (ASP) ', in Marketing Management. 2005, University of Economics and Business Administration: Vienna. p. 251.

[7] Morris, M.G.: 'A longitudinal examination of information technology acceptance', in School of Business. 1996, Indiana University: Indiana.

[8] Davis, F.D.: 'Perceived usefulness, perceived ease of use, and user acceptance of information technology'. MIS Quarterly, 13(3): 1989 p. 319-340.

[9] Davis, F.D., Bagozzi, R.P., and Warshar, P.R.: 'User acceptance of computer technology: a comparison of two theoretical models'. Management Science, 35: 1989 p. 982-1003

[10] Venkatesh, V., et al.: 'User Acceptance of Information Technology: Toward a Unified View'. MIS Quarterly, 27(3): 2003 p. 425-478.

[11] Hong, W., Thong, J.Y.L., and Tam, K.Y.: 'Understanding continued information technology usage behavior: A comparison of three models in the context of mobile internet'. Decision Support Systems, 42(3): 2006 p. 1819-1834.

[12] Kamel, G.E.: 'The impact of technology acceptance consideration on system usage, and adopted level of technological sophistication: An empirical investigation'. International Journal of Information Management, 17(4): 1997 p. 249-260.

[13] Porter, M.E.: 'Competitive Advantage'. New York: The Free Press. 1985.

[14] Peppard, J. and Rylander, A.: 'From Value Chain to Value Network: Insights for Mobile Operators'. European Management Journal, 24(2-3): 2006 p. 128-141.

[15] Allee, V.: 'A Value Network Approach for Modelling and Measuring Intangibles'. in Transparent Eterprise. Madrid 2002.

[16] Kochs, A. and Ansorge, J.: 'E-Motion Requirements and Service Analysis'. 2006. p.

[17] Van Essen, R., et al.: 'COMPOSE WP-3: Compose Demonstrator System & Services Requirements'. 2001. p. 201.

[18] Hellmark, D.: 'The Business Model for DAB based ITS Services'. 2002, Cap Gemini Ernst & Young: IST Road Transport Sector http://www.ertico.com/download/diamond_documents/2_5d004f01.pdf. p. 50.

[19] Fuchs, S. and Bankosegger, D.: 'SS18 COOPERS user reaction and impact assessment of co-operative services: User acceptance of COOPERS services - first results from the simulator study', in 7th European Congress and Exhibition on Intelligent Transport Systems and Services. 2008: Geneva.

[20] Fuchs, S. and Bankosegger, D.: 'Focus Groups with potential COOPERS End Users', S. Fuchs and D. Bankosegger, Editors. 2007: Vienna.

[21] Fuchs, S., et al.: 'COOPERS IR 2600/2700-1 Market and User Assessment. Focus on Market Analysis and User Needs'. 2007, Vereinigung High Tech Marketing: Vienna. p. 19

[22] European Commission (2009). *Draft Standardisation Mandate on co-operative systems*. European Committee for standardization, Brussels.

[23] European Data protection supervisor (2009), *Opinion of the European Data Protection Supervisor, Brussels, http://www.edps.europa.eu*

[24] eSecurity working group (2009*), eSecurity Internal Working Document, eSafety Forum,* Antonio Kung, Brussels

[25]CVIS (2006). *D.DEPN 3.1.: Safe Secure & fault Tolerant Design*, Paul Van Koningsbruggen, Nol Venema, Brussels, www.cvisproject.org

[26] CVIS (2008) *D.DEPN 4.1: Utility, usability and user acceptance,* Jasper Pauwelussen, Marika Hoedemaeker, Fred Verweij, Michele Francano, Maria Paola Bianconi, Brussels, www.cvisproject.org

[27] CVIS (2008) *D.DEPN 6.1: Risks & Liabilities,* Marion Robery, David Martin-Clark, Brussels, www.cvisproject.org

[28]CVIS (2006) *D.DEPN 7.1: Guidelines for Policy Makers: The policy impacts of CVIS,* Neil Hoose, Fred Verweij, Brussels, www.cvisproject.org

[29] CVIS (2009) *D.DEPN 8.1: Deployment Roadmaps,* Mats Rosenquist, Pontus All, Strömdahl Annika, Brussels, www.cvisproject.org (to be published)

30 CVIS (2010) D.DEPN 5.1: Business Models and Cost Benefit analysis, Henk JAn Booiman, Brussels www.cvisproject.org (to be published)

[31] European Commission, Action Plan for the Deployment of Intelligent Transport