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**Guidelines for policy makers: policy challenges on the way to deployment of CVIS**

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**Abstract**

The capability to link vehicles to the roadside and to each other through seamless communications channels (Cooperative Vehicle Infrastructure Systems – CVIS) creates many opportunities for far reaching innovations in the way the road network is used and traffic is organized. A corresponding change in policy thinking and bridging the gap between infrastructure providers and vehicle manufacturers to gain the co-operation needed require significant challenges to be addressed. These challenges include a common

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**IP Manager** Paul Kompfner, ERTICO – ITS Europe
Tel: +32 2 400 0700, E-mail: cvis@mail.ertico.com
Guidelines for Policy Makers

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## Abbreviations and Definitions

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<th>Definition</th>
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<tr>
<td>ADAS</td>
<td>Advanced Driver Assistance Systems: Vehicle based sensor and computing that provides drivers with advice about safety and performance and can assist with the driving task.</td>
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<td>AHS</td>
<td>Automated Highway Systems</td>
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<td>APEC</td>
<td>Asia-Pacific Economic Cooperation</td>
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<td>CALM</td>
<td>Communication Access for Land Mobiles</td>
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<td>CCTV</td>
<td>Closed-circuit television</td>
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<td>COMO</td>
<td>Cooperative Monitoring (sub-project in the CVIS project)</td>
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<td>CTA</td>
<td>Cooperative Traveller’s Assistance</td>
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<td>CURB</td>
<td>Cooperative Urban Applications (in the CVIS project)</td>
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<td>CVHS</td>
<td>Cooperative Vehicle Highway Systems</td>
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<td>CVIS</td>
<td>Cooperative Vehicle Infrastructure Systems</td>
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<td>EC</td>
<td>European Commission</td>
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<tr>
<td>EDA</td>
<td>Enhanced Driver Awareness</td>
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<td>EDPS</td>
<td>European Data Protection Supervisor</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>FOT</td>
<td>Field Operational Test</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>ISO</td>
<td>International Organization for Standardization</td>
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<td>ITS</td>
<td>Intelligent Transportation Systems</td>
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<td>IVIS</td>
<td>In-vehicle information systems</td>
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<tr>
<td>LPR</td>
<td>License Plate Recognition</td>
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<td>MINAMI</td>
<td>Micro-Nano integrated platform for transverse Ambient Intelligence applications</td>
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<tr>
<td>OBU</td>
<td>On-Board Unit</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>POLIS</td>
<td>Polis is a network of European cities and regions from across Europe, which promotes, supports and advocates innovation in local transport</td>
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<tr>
<td>PPP</td>
<td>Public Private Partnership</td>
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<td>RDS</td>
<td>Radio Data System</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>SAFESPOT</td>
<td>Integrated European project to design cooperative systems for road safety based on vehicle to vehicle and vehicle to infrastructure communication</td>
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<tr>
<td>TMC</td>
<td>Traffic Message Channel</td>
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<td>V2V</td>
<td>Vehicle to vehicle</td>
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Executive Summary

The capability to link vehicles to the roadside and to each other through seamless communications channels (Cooperative Vehicle Infrastructure Systems – CVIS) creates many opportunities for far reaching innovations in the way the road network is used and traffic is organized. A corresponding change in policy thinking and bridging the gap between infrastructure providers and vehicle manufacturers to gain the co-operation needed require significant challenges to be addressed. These challenges include a common roadmap for the deployment of CVIS and raising awareness and commitment among policy-makers. The objective of this document is to give an overview of the main areas of policy that CVIS will interact with and to provide a number of recommendations from the policy perspective. It is intended to give rise to debate and to stimulate further policy discussions and related actions on the way to deployment. The target audience is policy makers seeking to understand where and how CVIS might impact on policy areas and how they could anticipate on this.

Policy areas

The use of CVIS to exchange data among vehicles and the roadside greatly enriches the available data in vehicles, traffic centres and among other stakeholders who will be involved. The use of that data creates almost an infinite number of opportunities. Drivers could be warned for hazards down the road, which they do not see yet themselves. Traffic centres could receive more information for an optimal management of the road network. At home people could get better, real-time information for planning their trips. The (potential) far-reaching consequences of CVIS imply an important impact on policies on efficiency of mobility, road safety, public transport and freight transport as well as impacts on environmental policies, telecommunications and privacy. In a broad inventory, based on a literature review, these affected policy areas were identified.

The growth of congestion and its undesirable economic, environmental and social effects represents a major concern for transport policy makers. The use of CVIS to provide cooperative monitoring leads to a greater knowledge about the way the road network behaves under a variety of conditions. This knowledge can be used to improve the way congestion is managed. 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. It may also be used to provide re-routing to approaching vehicles and to give information for travel planning. The network operator will put out information to influence traveller’s behaviour to optimise the network use given the broader transport policies that are in place. This will be in conjunction with the traffic control strategy. 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 CVIS techniques to improve the information available to drivers to support “better” decision-making.

The influence that CVIS can have on road safety is one of its most powerful levers. At the level of the road-user CVIS may be able to offer a greater degree of assurance than vehicle based systems such as ADAS, because it can obtain data from beyond the range of the vehicle sensors. Although reducing casualties across the board is clearly the current overarching
public policy, CVIS can also provide instruments to put greater emphasis on reducing accidents in particular groups, e.g. child pedestrians.

Another key aspect of CVIS is that the dynamic allocation of available capacity by type of vehicle or trip purpose becomes possible. A policy of making traffic lanes available to public transport and other high occupancy vehicles can be implemented without necessarily needing physical changes to the road. Freight movements can be managed more directly as well. In this way the use of available capacity can be matched to more specific policy initiatives that seek to favour particular uses of the network. This approach can be used alongside broader policies on land use and traffic generation (employment, education, healthcare, leisure) that seek to reduce or redistribute trips.

CVIS also interacts with policies on reaching environmental goals, telecommunications and privacy. It is clear, that the opportunities CVIS offers to improve traffic management and to pay special attention to freight movements can also contribute to reach environmental goals. CVIS can contribute to minimize stops of heavy vehicles at intersections, to restrict access to vulnerable areas such as historic city centres, etc. In addition vehicle sensors could be used to gather more information on pollution levels. Regarding telecommunications, policies on the use of the radio frequency spectrum are relevant. Not only CVIS services, but also other personal services must be able to co-exist within the same part of the spectrum. CVIS is intrinsically linked to collecting, exchanging and processing (big amounts of) data. A part of this data is personal. Therefore, obviously there is also an important interaction with privacy policies.

Opportunities for policy delivery

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 policy 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. Participants also mention the potential conflict between route information from commercial providers and from network operators.
As mentioned before, the network operator will try to optimise the use of the network taking into account the broader transport policies. This advice can be different from the information from commercial providers based on an individual optimum. This calls for a broad cooperation of providers of routing information. Other potential conflicts mentioned in the session concern the overall effects on road safety and privacy protection.

**Policy challenges**

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). In addition a questionnaire was sent to policy-making organizations in all EU-countries, completed with Norway and Switzerland. 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.

In comparison with the technical developments, at the national level political discussions on the deployment of CVIS seem to lag behind. Interviewees expect it could be difficult to get CVIS on the political agenda. They believe insight in the cost effectiveness of deployment is a prerequisite in this respect. Political discussions on the cost-effectiveness should also include the contribution to sustainability and road safety, although they are not easy to quantify. Special attention is necessary for raising realistic expectations for the first period of deployment (in which benefits are probably still limited) and the contribution to long-term governmental objectives should be made univocally clear. Furthermore interviewees advise to thoroughly discuss policy conflicts related to CVIS, such as mentioned in the interactive session.

The interviewees indicate that to further develop CVIS, initially many Field Operational Tests (FOT’s) should be carried out. Each FOT should aspire to learn as much as possible from the development of one specific application in one particular context. In this phase it is crucial to keep options open. The next step is to broaden these developments to various contexts. Through benchmarking and cross-pollination, various learning experiences can strengthen each other in one and the same direction. 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. Therefore common specifications and standards for the use and operation are needed for Europe as a whole. It is essential to already start working on standards, but in the initial phase in a “loose” form. The standards should be motivating to keep experimenting and innovating, while at the same time be a legitimisation for investors to contribute to the deployment.
**Recommendations**

Based on the interviews and questionnaires a number of recommendations for policy makers can be formulated to ease the deployment of CVIS in Europe. These recommendations concern challenges related to finance, cooperation, the user perspective and governance. From these, “finance” is seen as the most dominant issue. In order to participate in the development of CVIS it must be clear to stakeholders that benefits will outweigh the costs. Moreover, an effective cooperation is needed between public and private stakeholders, a careful handling of privacy issues and a suitable government strategy.

The deployment of a data exchange platform like CVIS goes along with high initial costs, but will probably also generate rising benefits in time. To be able to weigh these financial flows, it is recommended to develop a business case at the EU-level. A viable business case will help to put CVIS on the political agendas and stimulate investments. A viable business could also be a good base for the necessary cooperation of stakeholders to deploy CVIS. A suitable Public-Private-Partnership (PPP) is crucial for this cooperation.

Considering the user perspective, privacy protection is often mentioned as the most vital challenge to overcome. However, the interviewees state that techniques are already available to guarantee privacy protection. Moreover, in flight traffic, public transport and for the use of mobile phones the processing of personal data is generally accepted. Therefore, if the issue of privacy protection is handled with care and communication about the subject is open and transparent (very important!), the interviewees expect no insurmountable obstacles in this field.

Regarding “governance” – in line with the findings above – the political agenda plays a crucial role, as well as gaining more experience by doing experiments or FOT’s. 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 CVIS 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 CVIS introduction. For their further strategies the ratios between opportunities and obstacles that they perceive for deployment of CVIS might give some guidance. These strategies can range from facilitating, stimulating and monitoring to anticipating.

It is clear that the complexity of the policy environment of CVIS and the multitude of stakeholders and relations necessary to deploy CVIS create a major challenge. The CVIS project shows that the realization of an open, interoperable platform that can support diverse information based applications is a complex technical task. However, compared to the necessary technical efforts, policy issues probably are an even bigger barrier for deployment. May this report be a stimulus for policy discussions to overcome this barrier.
1. Introduction

The capability to link vehicles to the roadside and to each other through seamless communications channels (Cooperative Vehicle Infrastructure Systems – CVIS) creates many opportunities for far reaching innovations in the way the road network is used. Applications using integrated the vehicle and highway management and control systems, e.g. automatic lane keeping, bus platoons, automated freight vehicle lanes, have the potential to address some of the factors that currently act as limitations, principally the driver as sole controller of the vehicle, unrestricted access to all parts of the road network and uncontrolled mixing of disparate types of vehicle and traffic. These technologies could provide alternative ways of ensuring compliance with regulations that are currently carried out by external means, e.g. enforcement cameras, or physical means, e.g. speed humps, rising bollards.

CVIS technologies will not naturally evolve without external influence because of the different investment approaches of public and private sector. The public sector looks largely at social gains and benefits whilst the private sector considers revenue streams. In the case of CVIS, investment by the private sector in vehicle developments may yield wider social benefits. Bringing such a step change in policy thinking and bridging the gap between infrastructure providers and operators and vehicle manufacturers to gain the co-operation needed require significant challenges to be addressed.

The CVIS project primary objectives are to demonstrate the feasibility of an open, interoperable technical solution that can support diverse information based applications. However, the CVIS project acknowledges that any use of CVIS raises a number of very broad non-technical issues. These areas are being studied within the Deployment Enablers workstream of the project and this document considers one particular aspect.

The objective of this document is to provide an overview of the main areas of policy that CVIS will interact with, to identify new opportunities for policy delivery (and potential negative effects) and to provide a number of recommendations for policy. Policy is closely related to risk, liability, business case; indeed most of the non-technical areas. The CVIS project has separate deliverables on these topics so they are not covered in depth here. The discussion of policy tries to highlight where these areas will need policy guidance and where solutions to the CVIS issues in those areas relate to policy.

The target audience is policy makers seeking to understand where and how CVIS might impact on transport, economic and other policy areas. It will also be of relevance to technology, product and service developers seeking to understand the relationship of their developments to policy at European, national, regional and local levels.

The potential impact of CVIS on the way roads are used is substantial. This document considers the potential of the full range of CVIS, not solely those applications and technologies being demonstrated within the CVIS project. The document reviews the potential policy impacts of CVIS by area of policy, structured by policy area with a consideration of European, national, regional and local levels where appropriate. It focusses mainly on the identification of areas where policy issues may impact on system requirements for the CVIS project applications, and where CVIS deployment may create additional or new risks to an existing policy area.
This document discusses CVIS in its broadest terms and at a high level that is deliberately non-technical. The document does assume that the reader is familiar with the broad concepts of CVIS in respect of vehicle to vehicle and vehicle to roadside communications and that they also have a background understanding of development in ITS and ADAS.
2. Approach

2.1. Process

The approach to realize this document consisted of four steps, which are shown in figure 2.1.

The first step is a broad inventory, based on literature review. This leads to an overview of the main areas of policy that CVIS will interact with and a description of the impact of CVIS. Risk, liability and business cases are closely related to policy. The CVIS-project has separate deliverables on these topics. Therefore they are not covered in depth here.

The results of step 1 intend to give rise to debate and do not provide solutions to policy questions. They are part of the input for the next step in the process.

The second step is an interactive session during a workshop with professionals working in the field of transport policy and cooperative systems. Inputs for this workshop are the results of step 1, experience from the CVIS and Safespot projects and results from previous meetings with POLIS. In the workshop the participants verify and add items to lists of new opportunities for policy delivery related to cooperative systems as well as potential negative effects and obstacles for the introduction. They also set priorities.

The third step is a number of interviews with key policy-makers working in this field and an additional questionnaire sent to a big number of policy-making organisations. Inputs for these interviews and the questionnaire are the results from the workshop. Policy-makers are asked to react on the results from the workshop, to explain their present national policy on cooperative systems and the policy they advocate for the future. Based on this, important policy challenges are formulated and analysed.
The fourth and final step consists of drawing up a number of recommendations based on the results of the interviews.

2.2. Structure of the document

The structure of this document corresponds with the approach described above. The next chapter gives an overview of the main areas of policy that CVIS will interact with, based on a literature review. Chapter 4 describes the interactive session during the workshop, chapter 5 the interviews with policy-makers and chapter 6 contains the recommendations.
3. Relevant policy areas

3.1. Transport Policy: Mobility and efficiency

3.1.1. CVIS and congestion

The growth of congestion and its undesirable economic, environmental and social effects represents a major concern for transport policy makers. The EU White Paper (European Commission, 2001) quotes the economic cost of congestion as 0.5% of GDP, potentially rising to 1% by 2010 if left unchecked. Levels of congestion vary across the EU by location, time and extent and it is growing more or less continuously. There is little consensus on the solution although it is clear that it requires multiple, complementary measures. It is also an area where the role of CVIS could be many and varied. For example, the use of CVIS equipped vehicles as data probes (see the CVIS COMO sub-project) will enable congestion to be identified and characterised in real time. It also provides information on the state of the rest of the network that can be used to determine what advice to provide to travellers. CVIS then provides routes by which information can be relayed to different groups in ways that are most relevant to them. If a control action is required, for example lowering speeds to prevent vehicles colliding with the end of a queue then CVIS technologies can be used.

One problem that needs to be addressed is that of the perception of CVIS. Most people will instantly think of the most extreme instance of a fully automated system where vehicles are completely controlled from outside and the driver has no substantive role. Furthermore, such a concept is seen entirely as for the benefit of private motorists and hence encounters significant political opposition. This is not a new problem and has been pointed out in much of the literature on intelligent transport systems (ITS) and automated highway systems (AHS), see Jones and Polak (Jones, et al., 1994) and (Cluett, et al., 1995). It is an important consideration when developing policy towards congestion that the objective of the policy and the anticipated role of CVIS are made clear and well explained.

Undoubtedly, the area of dynamic route guidance represents a delicate problem for public policy and CVIS. There has been a substantial growth in autonomous satellite navigation product sales in the period since 2002. At the same time there is a growing realization of their limitations in respect of avoiding congestion and increasingly a dynamic traffic information service is being bundled with the in-vehicle device (e.g. RDS-TMC). Thus a commercial market is developing from individual and business users. However, in the eyes of some, this is encouraging private vehicle use (cars and vans used for business purposes are considered part of this group) and that this is undesirable and unsustainable. Therefore any public policy that explicitly supports such systems will hit political difficulties. Indeed, Jones and Polak (Jones, et al., 1994) reported that Vienna and Zurich had explicitly ruled out any publicly supported dynamic route guidance on just those grounds, i.e. that they would encourage more car traffic into the city.

The use of CVIS to provide co-operative monitoring greatly enriches the available data and this in turn leads to a greater knowledge about, and understanding of, the way the road network behaves under a variety of conditions. This knowledge can then be used to improve the way congestion is managed. The way in which congestion is managed is clearly a policy...
matter in the first instance. The policy may be based on giving more priority to certain groups within the traffic stream, e.g. public transport vehicles, high-occupancy vehicles. It may also be used to provide re-routing to approaching vehicles in order to manage pollution levels although these alternative routes may not necessarily be the optimum diversion provided they are perceived by the driver as better than being part of the congestion.

There are three principle sources of congestion; recurrent situations where demand regularly exceeds available capacity, deliberate reduction of capacity to below demand level as typified by roadworks and unforeseen events such as accidents. The policy towards how each type is managed may be different. For example, in the case of recurrent congestion then this may be targeted by demand management measures such as pricing. In this case CVIS techniques may enable a more flexible and dynamic approach to pricing (e.g. different prices for vehicles with different characteristics at different times and in different areas) subject to the scheme being both understood by users, enforceable and economic. On the other hand unforeseen congestion might be managed through dynamic re-routing with preference for the best alternative route being given to particular groups such as public transport vehicles.

3.1.2. CVIS and reliable journeys

Greater emphasis is being placed on creating reliable journey times by all modes, even though that may include some element of congestion or delay. The objective is to provide travellers and goods shippers with the information that enables them to plan the timing of journeys in respect of start time and likely duration. The first generations of information systems are available but these tend to have limitations in the sophistication of their predictions. They are based on extrapolation from historical data sets and tend to be either unduly pessimistic because they are based on the longer tail from the historic distribution, or inconsistent because they are based on an average value that does not take into account the degree of variation. In both cases they do not try and consider the current influences on travel that may affect the estimate of future journey times. CVIS has the potential to improve quality and detail of the information available, reference the importance of the COMO workstream within the project.
A policy of promoting and enabling much greater data collection has benefits in many applications not just improving reliability of journeys. Furthermore, using vehicles and mobile sensor platforms, even for as simple a data set as time, position and speed, is likely to be very cost effective when compared with instrumenting the road network to achieve similar density and quality of data. However, the problem arises of creating a sufficiently strong “co-operation” for the vehicle owner so that they can clearly see the answer to the question “what’s in it for them?”. Moreover, the issue of individual privacy has to be addressed (see section 3.8).

3.1.3. CVIS and traffic control

Traffic control systems to date have been focussed on optimising the movement of traffic either by maximising flow or minimising delays. In recent years selective detection of public transport vehicles has been introduced to give greater priority to those vehicles based on a simple form of interaction using either an inductive loop and vehicle transponder or microwave tag and beacon. The same techniques are also used to control rising bollards and barriers as part of access control systems.

A shift in policy thinking is taking place in respect of the way traffic control systems are used. More direct intervention to deliver particular policies is now being considered instead of an optimisation approach. The sorts of policies include extending the priority and precedence given to public transport, promoting cycling and walking and environmental improvement. The aim is use the traffic control systems to balance the competing need for green time and access in a way that promotes these policies rather than trying to achieve an optimal solution to a set of constraints.

CVIS has a number of ways it can interact with traffic control systems. The policy question relates to how strong that interaction is and whether the network operator is adopting a highly assertive approach where the infrastructure system takes a significant amount of control, e.g.
limits maximum speed, slows vehicles on approach to junctions, or whether CVIS techniques are used to improve the information available to drivers to support “better” decision making by travellers. The former will be more expensive to implement, may require legislative and liability changes to overcome user resistance but is more certain to meet policy targets, for example reductions in vehicle emissions or reductions in accidents. The latter approach is much softer and so will be easier to implement, is less reliant on the numbers of vehicles that are CVIS enabled and is more consumer oriented but it is far from certain what the actual effect on policy delivery might be. The two approaches are not mutually exclusive and the more passive approach may be used first and then gradually “hardened” in order to reach the policy targets. However, there are implications for system design and therefore a clear direction will be needed as to whether the gradual ramping up of system control is a real possibility.

3.1.4. CVIS and travel information

One set of applications that could benefit substantially from CVIS are those related to travel planning and en-route information. CVIS (Mathias, et al., 2006) permits a much richer data set of traffic patterns to be collected than roadside systems can achieve. The extent to which CVIS penetrates the vehicle fleet may have a significant effect on the function and form of roadside data collection systems. However, until in-vehicle systems that can remotely report location, vehicle characteristics, speed etc. are deployed in sufficient numbers then there will remain a need for some infrastructure based technology. Furthermore, in order for coherent information to be extracted access to both vehicle-derived and roadside data together will be required.

There are policy questions relating to the ownership and sharing of data. The first area of concern is whether data can be used to identify an individual and hence what is the policy on privacy? Are there certain situations where data collected for information and management purposes can be accessed, say by the Police as part of a criminal investigation, and what is the obligation on the data collector to retain such detailed information? If, as seems most likely, the data is being collected by a private sector organisation as part if its service provision what are its obligations in respect of sharing data with other commercial parties or the public sector? Similarly, is the public sector obliged to make data available to individuals or commercial organisations, for example under data protection or freedom of information legislation, and what is the basis? For example, the policy could be that public sector data is made available in “slow-time” for all and in “real-time” on a subscription basis, subject to all individuals remaining anonymous. Jones and Polak (Jones, et al., 1994) pointed out the tension between the public sector need for “open access” and the private sector’s desire to enhance value through restricting those who can have access and placing commercial obligations on them in order to gain that access.

The accepted wisdom is that there needs to be a clear policy in this area despite the fact that ownership of a mobile phone raises many of the same issues, as do some of the new “pay as you drive” insurance products that use on-board tracking devices. The key difference may be that these are consumer services that an individual can opt to use and that there is no perceived role by the public sector. Therefore, this policy area needs to be clarified for those applications that require public-private partnership or are wholly within the public sector.
The other side of the traffic information equation is communication of information to those who are moving goods or travelling. The CVIS concept of “always connected” means that a greater range of information will be available at any location and point in time. There will also be a range of sources of information. Some information might be received from other vehicles via a local ad-hoc network; some might come from commercial services that have been subscribed to; some might come via intelligent agents searching on behalf of the user and some might come via a service provided by a public sector highway network operator.

The range of information sources combined with the difference in importance of different information raises a number of policy related issues. The question of policy in respect of the human machine interface is discussed in section 3.3. This section considers the issues relating to trust, quality and hierarchy of information.

A user will subscribe to a commercial information service on the grounds that they receive some value from it and that is possibly gives some advantage over travellers using an alternative service or those without information. The network operator will put out information to influence traveller’s behaviour to make the network operate in the most effective way given the broader transport policies that are in place. This will also be in conjunction with the traffic control strategy. These two different sources, commercial service and network operator, may give different advice because the individual travellers optimum and the network best options are not necessarily the same. At present it is down to the user to decide which advice to follow. This has already started to raise issues when navigation systems instruct drivers to take unsuitable diversions, or even to make illegal manoeuvres. CVIS may reduce these mismatches by keeping information more current through on-line updates but there will need to be a policy developed that allows greater harmonisation of advice between private services and network management.

3.1.5. CVIS and demand management

Road pricing and parking management use price mechanisms to regulate the demand for finite quantities of road capacity and parking space. CVIS is not required to implement such schemes but it can be used to increase the flexibility of the scheme and could play a role in improving acceptability and compliance. From a policy perspective the question is to what extent CVIS can enable barriers to implementation to be overcome and how can it improve the efficiency and effectiveness of demand management schemes in the longer term?

One application where CVIS are required is when trying to balance demand across the road network, and potentially the whole transport network. In this case real-time navigation is based on the allocation of routes to vehicles instead of each vehicle trying to determine its own optimum. These basic concepts are not new; the AUTOGUIDE system proposed for London in the late 1980s was just such a system, but the availability of more comprehensive and pervasive communications systems make it much easier to implement such techniques.

If the overall policy is to take a much more interventionist role in managing the network, seeking to push demand towards available capacity in space, time or mode, then route allocation is an attractive option.
3.1.6. CVIS and sustainability

One of the major sources of concern identified during the Automated Highway Studies in the USA and in some papers on ITS in general, e.g. (Kanninen, 1996), (Chang, et al., 1997), (Jenkins, 1994), (Cluett, et al., 1995), is that by improving the traffic flow further latent demand is released which means that the situation in respect of congestion, safety and environmental impacts may not improve. In other words, it can be argued that CVIS merely promotes travel by car and reinforces all the issues of long term lack of sustainability.

Whilst this line of argument is clearly very powerful it is based on viewing CVIS, particularly the more advanced possibilities is offers, as either in isolation from, or in competition with, alternative approaches. This is not the case. The current road network can be made more efficient and just as importantly more reliable through CVIS. This serves to maximise on the investment already made in fixed infrastructure. The CVHS business case study (Department for Transport, 2005) by the UK DfT estimated that CVIS techniques could extend the available capacity of a given road (i.e. delay the need to provide additional physical capacity) by up to 15 years.

One key aspect of CVIS is that it creates an information rich environment down to the individual vehicle level. This means that the dynamic allocation of available capacity by type of vehicle or trip purpose becomes possible. Thus, a policy of making traffic lanes available to public transport and high occupancy vehicles in response to traffic levels, that is maximising the throughput of people not metal, can be implemented without necessarily needing physical changes to the road (Griglione, et al., 2006). Freight movements can be managed more directly as well.

Thus use of available capacity can be matched to more specific policy initiatives that seek to favour particular uses of the network. This approach can be used alongside broader policies on land use and traffic generation (employment, education, healthcare, leisure) that seek to reduce or redistribute trips. These clearly take longer to come to fruition.

3.2. Transport Policy: Road safety

3.2.1. CVIS and new opportunities

The influence that CVIS can have on safety is one of its most powerful levers. At the level of the consumer then CVIS may be able to offer a greater degree of assurance than an ADAS system because it can obtain data from beyond the range of vehicle based sensors. From the perspective of the public authorities CVIS has the potential to reduce casualties. This could involve use of CVIS as an information route to provide more specific information about hazards ahead or the use of CVIS as part of a control systems limiting access or speed. The CF_F project (Kovacs, et al., 2006) includes the use of CVIS to control the movement of hazardous goods in areas of high sensitivity. It should be noted that CVIS solutions can provide benefits across multiple policy areas. Methods that improve safety may also raise driver awareness and influence traffic flow so that efficiency is enhanced and emissions are reduced at the same time.
A key source of debate in respect of any system that increases the safety of the vehicle and its occupants is the potential issue of risk compensation. This is where drivers may assume a level of performance from CVHS and drive to that limit, or lose the skill and judgement associated with safe driving of non-CVHS vehicles. ADAS experience may help in understanding this. Farber (Farber, 1991) discusses the case for Automatic Cruise Control devices. The overall probability of a simultaneous failure of an automated system and the driver, resulting in an accident, is the product of the probability of a system failure and the probability of a failure by the driver to respond if the system cannot. Clearly, the issue here is to ensure that the level of driver attention does not fall so low that the overall performance is worse than without the system. In fact, the result needs to be substantially better in order to justify the benefits. In the case of a CVIS solution then either the probability of system failure must be lower or the cost benefit ratio higher than its ADAS predecessor, for a given probability of driver failure.

In this case the policy issues are closely aligned with issues regarding liability and the responsibility of the driver to be aware of whether the system is operating correctly, and to know how to react if it isn’t. This has implications for the ability of the system to report faults, or drops in performance that might lead to failure, and how the current system status is reported to the driver. Therefore, there will have to be a policy on system safety to complement policies on highway and vehicle engineering safety.

One of the key problems facing CVIS is that of “Chicken and Egg”. In order for the benefits to be realised, both infrastructure and vehicle fleet components must be present in sufficient quantity. Given that accidents are well spaced in time and location it is clear that safety applications of CVIS will need to be part of a wider policy perspective. Instead of tangible benefits from day one it may that there needs to be a substantial investment in infrastructure or incentive to vehicle producers and consumers on the basis of it being a matter of medium to long term policy. However, in order for this to be realistic there needs either to be very strong evidence from research and simulation that the expected benefits will accrue. The case will be stronger if worthwhile benefits in another area can be realised in the short term.

One important aspect of safety policy is where the improvements occur and whether this is seen as a priority area from a policy point of view. Whilst reducing casualties across the board is clearly the overarching public policy, greater emphasis may be placed on reducing accidents in particular groups, for example, child pedestrians. For CVIS to attract public support the case needs to be clear as to how the CVIS application will contribute to those areas of priority. For example, the use of CVIS techniques for intelligent speed adaptation could be used to set lower speed limits on roads near schools, residential and play areas at those times when the risk is greatest. At other times when the risk is similar to other parts of the network allowable speeds could be higher. Provided CVIS resulted in greater compliance by drivers, reduced speeds and hence reduced accident frequency and severity then it can be seen as delivering on a priority policy objective. Of course, using CVIS will have to make economic and operational sense when compared to alternatives that are perhaps more obvious in the way they deliver the policy objective, for example banning vehicles altogether or a high, visible presence of law enforcement teams.

Van den Heijden (van der Heijden, et al., 1995) argues that a vehicle centric growth in automated vehicle guidance systems was more likely because of the greater experience in vehicle based driver support systems and the ability of change in the vehicle fleet to be evolutionary. If this is the general case for all CVIS then it is likely that the safety oriented
systems will be targeted towards the vehicle occupants in the first instance and a clear policy steer will be needed to ensure that safety of others is required. A possible model for this is the EuroNCAP ratings which started by rating features for occupant safety but now include ratings for pedestrian safety as well.

3.2.2. CVIS and replacing existing techniques

CVIS has the ability to replace some techniques currently used for delivering safety policy. The driver and vehicle can be informed remotely of the current speed limit and the vehicles speed can be constrained. Alternatively, the vehicle can report to the infrastructure if the driver repeatedly ignores the speed limit. This could replace enforcement techniques such as speed cameras and physical restrictions such as speed humps or chicanes. The main advantage is that the restriction is continuous and not just at the enforcement point or physical restriction. The policy remains the same but CVIS may provide a more effective means of implementing it.

The enforcement of safety policy needs to be considered. In general where a safety measure involves operating some form of restriction, for example speed limits, the penalties for breaking the regulation are more severe, possibly even criminal in nature, than breaking a local restriction on some other aspect of travel, e.g. parking illegally, which is regarded purely as a matter of civil law. Alongside the safety policy there needs to be a clear policy on who is charged with enforcing any restrictions and how they use the CVIS system to carry out such enforcement. The issue here is to avoid making a stakeholder, such as a commercial system operator, responsible for an enforcement regime that is beyond their capability. However, at the same time such an operator must meet an obligation to record and manage data and information in such a way that the enforcement agency can successfully meet the evidential needs for robust and fair enforcement.

A problem arises with adopting CVIS to deliver safety policy when the traffic stream is mixed between CVIS and non-CVIS equipped vehicles. The safety gain may only accrue to those prepared and able to afford CVIS resulting in a safety policy that is not applied equitably. However, this may be offset by the “calming” effect of CVIS vehicles within the traffic stream, for example they may have the effect of limiting the speed of following non-CVIS vehicles. In practise many safety improvements now taken for granted in modern vehicles (e.g. ABS, airbags) were initially relatively expensive and only available to those who could afford to specify them. So, although market led deployment can be viewed as inequitable the principle of new features providing increased safety “trickling down” from expensive to mass market vehicles is well established and accepted.

3.2.3. CVIS and personal or societal benefits

Safety has both personal and societal aspects. At a personal level we mostly desire to be as safe as possible and the degree to which we seek to protect ourselves will be based on our own perception of the risk we face. A regular motorway driver might regard Automatic Cruise Control as a worthwhile feature to pay for on the grounds it enables him to maintain cruising speed whilst reducing the risk of running into a vehicle ahead, On the other hand someone who drives mainly on rural roads would not regard it in the same light. At the societal level
Safety has wider benefits. It reduces the need for emergency facilities; it reduces the costs in terms of human suffering and economic impacts of the long term effects of injuries and fatalities. Improved safety reduces the cost to the economy and environment of the resulting congestion. In general the consumer is encouraged (or in some cases forced) to pay for products and service (including training) that promote personal safety and the public sector pays for infrastructure investment (e.g. highway engineering) and perhaps incentives to encourage take up of products (e.g. publicity campaigns promoting seat belt wearing). Use of CVIS requires both aspects to work in harmony. The consumer (including business consumers such as freight hauliers) has to accept and pay for (not necessarily explicitly) the vehicle components. The public sector has to be able to identify the societal benefits and match them to policy priorities in order to justify the investment in the infrastructure components.

CVIS may influence safety in respect of reducing the latent potential for accidents. This may be by reducing the occurrence of conflicts between vehicle through direct action, such as maintaining a safe headway between vehicles in a co-operative platoon or by broadcasting presence to other vehicles in the vicinity of an intersection. It could also be by raising and directing the attention of the driver, perhaps by using an ad-hoc network to propagate a warning of the presence of a queue back through a stream of vehicles. This should translate into a measurable change in safety but the effect on driver confidence and reduction in stress may be perceived even more strongly. In respect of risk compensation, it could be argued that drivers who are less stressed are less likely to indulge in risky behaviour. However, the point here is that when considering CVIS it may be necessary to consider policy towards the driver’s state of mind, perception of the driving environment and whether the implementation will better focus driver’s concentration or have the undesirable effect of reducing concentration on driving. The question of driver competence and training is discussed further on section 3.5.

CVIS introduces a third element into the safety equation. Currently, there are two key components; the safety of the highway and non-vehicle users and the safety of the vehicles and their occupants with particular emphasis on the driver. There are two interfaces between these components, namely, the friction between the vehicle tyre and the road surface and the

**Figure 3.3 CVIS can use V2V communications**

![Diagram showing CVIS using V2V communications to provide advance hazard warning](image-url)
vision of the driver. CVIS introduces a new interface through the electronic systems that link between vehicles or between the vehicle and the infrastructure. The degree to which this component has safety implications depends on the applications for which it is being used but, nonetheless, consideration of the safety implications of the system will have to be included when developing policy. For example, if V2V communications is being used to manage vehicle headways will it be policy that all vehicles involved must also have an autonomous system (e.g. advance cruise control) to provide a fallback or will there have to be a second communication channel? Also, who takes the lead in implementing such policy? Is it the system suppliers seeking to manage their liability or the public sector seeking to minimise the potential for catastrophic accidents which, although they may be rarer, would capture the headlines in the press? In the latter case this implies some form of product/system standards or licensing.

3.2.4. CVIS and the public perception of safety

One of the challenges that CVIS faces is how the public perceive its safety, irrespective of what the actual engineering and statistical data might show. The obvious analogy is with air travel which many people perceive as high risk despite it having a safety record that is better than other modes. This may be due to a combination of individuals not having any control of what happens, the fact that such accidents as do happen are catastrophic and high profile and that much is made of safety issues (for instance train operators do not carry out a safety briefing in every carriage after every station).

An important factor is the degree of “trust” that the traveller has in the operation, for example, it is taken for granted that there are two pilots in the cockpit who are in control of the plane although the evidence for this is actually very limited, usually a disembodied voice stating that this is the case. In the case of CVIS the questions of trust in the validity and accuracy of any information and advice is important. This increases when the application also requires some relinquishing of control by the driver. Despite evidence showing that the automated system can react more quickly, consistently and smoothly than a human it is a big psychological leap to make. Therefore, any policy to promote CVIS as a solution to safety issues must be linked to policy on public information and training to ensure the perceptions match what is needed for successful deployment. This will have to commence in advance of that deployment.

It is not the purpose of this document to discuss issues of risk and liability as these are covered in separate deliverables from CVIS project DEPN Topic 6. CVIS does not require a change in road safety policy but it does change the way existing policy might be delivered. In recent years there has been a much stronger focus on enforcement of existing regulations, in particular speed limits and alcohol limits, with more severe punishment where a serious accident can be traced to driver fault. CVIS could be used to provide more continuous information to drivers on the current regulations they need to comply with, hazards they are approaching and as a route for “campaign” information messages. The technology could also be used for almost continuous enforcement through, for example, remote interrogation of the cars on-board data recorder to identify any transgressions. Clearly, there are issues of public acceptability but policy could be directed towards improving the information available to drivers at the time and location they most need it.
ADAS systems that address primary safety (i.e. the prevention of accidents taking place) are now on the market, for example lane departure warning, and further applications are being demonstrated by projects such as PREVENT, e.g. blind spot monitoring. CVIS can extend the capability in this area through advanced hazard warning (sometime referred to as “over the horizon”) beyond the range of vehicle-based sensors (see figure 3.4) or by supporting collaboration between vehicles, e.g. co-operative merging. In policy terms the question is open as to whether ADAS will deliver sufficient benefits on its own and whether an explicit policy direction to promote the CVIS extensions is required. The nature of the ADAS market will be highly influential in the how CVIS markets develop. Consumer confidence in ADAS will assist in creating acceptance for CVIS. However, if ADAS are seen as providing what the consumer wants then CVIS will either have to be cheaper or address an issue that ADAS cannot deal with but consumers regard as important.

3.3. Transport Policy: Public transport and freight distribution

3.3.1. CVIS and public transport

Studies into the potential impacts of Automated Highway Systems (AHS) in the USA during the 1990s (DoT, 1994) identified that there was a major concern that AHS would be viewed as pro-private transport and hence undermine policies and strategies designed to achieve a mode shift from private cars to public transport. Similar concerns have also been raised about
ITS (Wootton, 1995) in general, so it is inevitable that CVIS will be subject to the same arguments. The principle argument is that CVIS applications enhance the attractiveness of car travel and therefore reinforce behaviour that many believe is unsustainable, particularly in dense urban areas.

Whilst it is undoubtedly the case, that many CVIS applications do benefit private car users, it is not the case that this is at the expense of public transport, nor that it will necessarily influence the decision on mode choice. There are CVIS applications that can be beneficial for public transport, for example, by improving the provision of priority and assisting bus operators in running services reliably or by providing better comparative information on public transport journey times and capacity versus car based trips to the same destination. From a policy perspective the approach must be to consider how CVIS can underpin improvements on public transport operations and promote more informed choice by travellers.

3.3.2. CVIS and freight distribution

Road freight represents a significant challenge in policy terms. Freight vehicles are unpopular because of their environmental impacts, largely noise and visual presence but also there are concerns about emissions, especially particulates and their effect on health. That said, road freight is an essential component of the economy of any country. Policies are in place (European Commission, 2001) to promote modal shift from road to rail and water, but even if they were to double their tonnage carried that would only reduce road freight by a small proportion. In most cases the first and final kilometres of any haul will involve road transport. Growth in internet based retailing is increasing and this generates delivery trips by a range of vehicle types.
There are a number of areas where CVIS can enable innovative ways of delivering policies to manage the impact of road freight and the efficiency of road freight operations. These are initiatives that promote better planning of routes, timing and loadings, improved vehicle efficiency and safety by more effective controls on where and when freight vehicles can use the road network. There is a major challenge in creating a balance of policies that are seen by the stakeholders groups as fair and effective.

3.4. Vehicle Policy

3.4.1. Vehicle construction and use regulations

The testing and approval of new vehicles, their systems and components is a complex area with a swathe of EU Directives, principally Directive 70/156/EEC and all the subsequent amendments, backed up by supporting legislation in the member states. This covers “whole vehicle” approval and involves the inspection of a production version to confirm that the specification of the systems and components identified in the relevant individual directives meet the requirements.

Individual systems are approved either as part of a particular type of vehicle or as a Separate Technical Unit (STU). Each member state has to establish an Approval Authority that issues approvals and a Technical Service that carries out the testing required to achieve that approval. Figure 3.6 illustrates the number of areas that require approval for a passenger car and a coach.

Co-operative systems do not fit easily into the current framework for approvals as they cross the boundaries between driver and vehicle, between vehicles and between vehicle and roadside system. The functionality of the application is also a factor. Within the CVIS project most of the applications that are being demonstrated are benign, that is to say that the consequences of any failure are at most some inconvenience. However, the core technology platform is intended to be application independent and be capable of delivering future applications that may have more direct influence on vehicle behaviour. Therefore, there needs to be a clear policy on whether approval is based on the applications implemented or the technical capability available. Clearly there is a link to approval of ADAS technologies but there needs to be a policy on whether an approved ADAS can be linked to CVIS without further approval being required.

There needs to be consideration of what the policy will be towards approval for vehicle to vehicle communications and vehicle to infrastructure links. In CVIS all the vehicles connected to the network at the same time are part of the “system”, as is any infrastructure based component. Under what circumstances will it be necessary that all elements are “approved” and does a systems’ ability to detect and screen out unapproved components form part of the technical requirements for approval. The same question of whether this is led by application or technical capability needs to be resolved.

It is important that policy development, and hence the legislative and administrative processes that follow, is kept in step with technical and market developments. This did not happen in the case of mobile telephones and personal navigation systems with the result that restrictive
Figure 3.6 Statutory UK Approvals elements for a car and coach

Policy and legislation had to be introduced after the market had taken off and associated poor behaviour, i.e. loss of concentration due to taking phone calls, had become difficult to eradicate. This is because making phone calls whilst driving had become an habitual behaviour for many individuals. Identifying such problems is difficult because initial low penetration tends to mean that there is little evidence to show the effects of a lack of policy, and hence little attention is paid to the issue. However, a sudden and sharp increase in sales, which seems to be characteristic of ICT can result in policy being left behind and, thereafter, is always struggling to catch up.

3.4.2. Vehicle maintenance and testing

There is some harmonization at the European (Directive 96/96/EC) and internationally through the Vienna Agreement (UN-ECE 1997) on the minimum frequency of roadworthiness testing for different classes of vehicle and the items that have to be tested. However, the agreements do not set standards for testing and there is considerable flexibility for national...
administrations to derogate from the provisions of these agreements. As a result there is no reciprocity between member states and roadworthiness can only be certified in the vehicle’s country of registration.

At present there are no international requirements covering electronic and telecommunications based applications although the body that is charged with developing agreements, UN-ECE WP.29, has been made aware of the issue (Berry, 2003). This paper pointed out that electronic systems are also subject to aging although they are inherently more reliable. A further aspect of such systems is that much of their functionality is contained in software and this is likely to be updated periodically over the life of the vehicle. ICT based systems also tend to have a much shorter lifespan because of rapid development. Although backward compatibility is often a key feature this cannot always be guaranteed, particularly in respect of external interfaces. How many computers available in 2007 are capable of reading data stored on magnetic disks but in 2002 that was still the most common portable medium.

There is a further issue in respect of CVIS in that the infrastructure elements of the systems will have to be able to work correctly with all extant software versions that are in the vehicle fleet. Thus roadworthiness testing will not be confined to vehicle elements but must assess the efficacy of the interface to the infrastructure and to other vehicles.

This creates a whole new area of policy that will have to be developed at the international level. The need for harmonisation and reciprocity between member states testing regimes in order for safe cross border use of CVIS is clear. There are clear parallels with rail and air safety regimes and good practise from those sectors needs to be used to develop CVIS system and vehicle maintenance. However, the scale of the road sector combined with the fact that it involves a mix of professional staff and consumers mean that a straightforward transfer of approach will not be appropriate.

3.4.3. Human-machine interface

The range of basic issues in respect of the interface between systems and drivers has already been encountered in the development of in vehicle information systems (IVIS) and advanced drivers assistance systems (ADAS). CVIS increases the complexity of some of the questions of responsibility as the supply chain for the application involves both infrastructure and real-time elements as well as individual products. From a policy perspective the key question is whether the existing policies towards IVIS and ADAS are adequate to deal with CVIS driven applications instead of autonomous situations?

The issues in this area are complex and are bound up with legal and risk issues. Currently the guidance is very clear that “The manufacturer has a duty to warn users of dangers present in using the system both in normal and foreseeable misuse” (Stevens, et al., 2001). How should this be interpreted when the system is obtaining data from external sources? If it remains the overarching policy that “Drivers are responsible for the proper control of their vehicle” then how are they to be made aware of the influence of CVIS?

The interaction between a technological system and the human user needs to fulfill the needs of that human. These are far from homogenous and are subject to wide range of influences including personal choice, cultural expectations, physical and intellectual limitations and the nature of what else is going on around the user at the time of use. Policy making in this
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subject area has to identify the key areas where minimum standards are required to ensure public and user safety, and the sanctions to be applied of those standards are not met.

A central aspect of any system based on exchange of information between a wide variety and large number of entities is trust. The recipient has to trust that the information received is fit for purpose, is accurate and timely and has been obtained in a legal and safe manner. In CVIS a chain of data and information may be involved. For example, data obtained by a local traffic control centre from individual vehicles using CMON technology may be filtered and passed as a description of current network conditions to a regional travel information centre that may generate a forecast of traffic conditions for the next few hours. This information may be picked up by a freight management centre that uses it to propose efficient routes for delivery vehicles and the vehicle operator may then use those proposals to arrange a delivery slot using the approach being developed in the CF&F project. Each link in the chain trusts the previous link to meet the quality requirements. Although each step can carry out some context checking, for the system to work effectively everyone has to be trustworthy.

Therefore there needs to be a policy on how “trust” is assessed and what level of trust is required for each actor in the information chain. However, the CVIS project concept of “always connected” is analogous to the arrangement of the world-wide web where the basic rule is “caveat emptor” and users make judgments about which sites they place their trust in. For CVIS applications the user does not have the time to make judgments at the time of information use and so there needs to be a method for ensuring that only trusted services can be accessed. If community derived services are to be supported there needs to be a clear policy on what sort of services are allowed and how trust is to be maintained throughout the service delivery.

3.5. **Drivers**

3.5.1. **Driver education**

CVIS applications have the potential to improve safety by improving the quality and flow of information to drivers and, in the longer term, actively assisting in the driving task itself. However the basic policy, and indeed the legal position, is that the driver is responsible for being in control of the vehicle. ADAS products such as advanced cruise control adhere to this principle and there are considerable obstacles to overcome (Stevens, et al., 2001) before any aspect of CVHS can deviate from it.

CVIS systems should not require any increase in driver skill as they are intended to make the driving task both safer and easier. However, there is a need for the driver to understand what the system is doing and how they should interact with it. This means that there is a need for CVIS systems to appear the same to all drivers and for some form of training prior to use. Currently ADAS systems are regarded as part of the product and manufacturers and retailers provide the training, largely through the user manual, perhaps augmented by verbal instruction when the vehicle is handed over. In the case of rental or used vehicles neither of these may be available.

There may need to be a policy in respect of the interface for CVIS that certain key important aspects become the norm across all vehicles equipped with this technology. These aspects
include what systems the vehicle is fitted with, whether the default setting is on or off, how
the driver is aware of this and how, if permitted, the driver can de-activate the systems and
resume complete control whilst driving. Also of crucial importance are how any detected
faults are communicated to the driver and what their reactions should be?

Obviously all these features should be as intuitive as possible but there will be a need for
drivers to be able to assess what the car is fitted with, whether it is in on and whether it is
working correctly as soon as they sit in the driving position. Ideally, this is a policy that can
be agreed between the suppliers but they may be reluctant to propose complete commonality
because of the pressure to achieve product differentiation and competitive pressures in respect
of production costs. If this is not being achieved it may be that the public sector will consider
the safety implications and put in place a more explicit policy. This policy may not only cover
the design of the interface to the user but also could extend the training requirements.

There is a shift in skills and awareness that the evolution from current vehicle technology,
through ADAS and towards CVIS brings about. The change is from an emphasis on the
driving task itself to being able to monitor the driving environment and the systems that are
assisting the driver to remain safe within that environment. The importance of that awareness
by the driver varies with the function of the CVIS system and the consequences of a system
failure. If the CVIS application is providing information on route or parking location then a
failure may result in inconvenience, whereas if it is providing information on speed or access
permissions then the failure could result in the driver being penalized for contravening a
regulation. Ultimately, any system that shares control with the driver needs much more
awareness by the driver as its failure could be catastrophic and lead to a collision or worse.

The range of interactions and consequences of failure means that there will need to be a
sophisticated approach to policy development in this area. A “one size fits all” approach is
unlikely to be sufficient as it will either be inadequate because it does not recognise the
consequences of a lack of skill on the part of the driver in monitoring the performance of the
CVIS application, or it will be too onerous and may stifle the introduction of beneficial but
relatively benign applications. In other words, automated lane keeping should be subject to a
more rigorous consideration of the drivers role than, say, permitted use of bus lanes which in
turn may need a greater degree of training and awareness by the driver than a dynamic route
guidance service.

3.5.2. Driver testing and licensing

Driving standards and tests to obtain a license are set nationally, but accepted internationally.
There are different standards and tests required for different types of vehicle, for example
heavy goods vehicles, public service vehicles, and (certainly in the UK) a difference is made
between being trained to drive on a vehicle with an automatic gearbox and a manual gearbox
(the former are not permitted to drive the latter but not vice versa).

The harmonization of licensing is continuing at the European level. This is a long term
process and various directives (e.g. 80/1263/EEC, 91/439/EEC) are already in place. Therefore
CVIS needs to be considered as part of the European Union policy on driver
standards and licenses as well as within national jurisdictions.
The central question is whether competence in the use of CVIS should fall within the remit of driver testing, and if so, what are the characteristics of a product or service that would mean its users have to be licensed?

In the case of professional drivers increasing the training and testing requirements is much more easily accomplished than for the general public. Where a CVIS application creates a benefit to a professional operator, and that includes safety, then an economic case for driver training can be made. For the general public, obtaining a driving license represents a significant achievement at a personal level and also a non-trivial cost. Anything that makes that harder or costlier is not going to be accepted.

An interesting dichotomy could open up. If CVIS applications are implemented that make driving easier for all, and also make driving possible from some groups who have an impairment that would bar them at present, then should it be possible to be trained just to drive with CVIS assistance and the license restricted to vehicles with those facilities. Such a license might be easier to obtain, might allow older people to have the ability to drive for more years and could provide mobility to a greater range of disabled individuals. The price of this is being restricted to vehicles with CVIS capability and possibly to those parts of the road network that have the matching infrastructure.

Alternatively, CVIS could be used for professional drivers and for access to certain “high performance” sections of the network. In this case there may be a need for a higher level of competence over and above that of the standard driving license. This raises the question of who sets the standard and who is the licensing authority. It could be an extension to the existing public sector approach or it could conceivably be a function of the operators of the high performance network who could be public or private sector.

The idea of a further test that gains you some benefit is already current in the UK where passing the Institute of Advanced Motorists (a private sector organisation) test is recognised by some insurance companies as a mark of a more skilled driver who is at lower risk of an accident and hence qualifies for a discount. In a similar way, some “pay as you go” insurance schemes targeted at younger drivers encourage where and when drivers should be on the road through the use of variable premiums. Driving late at night on rural roads is regarded as a high risk and the premium per kilometre that is charged is significantly higher when the on-board unit records such behaviour. Although the driver is not barred from any parts of the network under such regimes the principle of access being at a premium is established, albeit on a voluntary basis. Therefore it is possible to envisage CVIS training being an additional and separate qualification from the standard driving training.

### 3.6. Environmental policy

#### 3.6.1. CVIS and vehicle emissions

This section considers to what extent CVIS supports or enables implementation of policies designed to reduce the impact of road-based travel on the environment. The discussion focuses principally on exhaust emissions but the same arguments can be advance in respect of noise and vibration. At the level of the individual vehicle, it is the better management of fuel
use which can provide both benefits in terms of emissions but also reduce resource use and operating costs for the owner or user.

One potential way is to improve the flow of information and to assist in managing levels of pollution. For example, CVIS would support continuous (or near continuous) remote monitoring of engine performance by the owners service or maintenance supplier. Instead of waiting until an annual inspection is due and testing at that stage a driver can be informed more or less immediately the vehicle ceases to operate within the legal levels. CVIS data gathering could be used to provide more information on pollution levels either through uploading data from vehicle emissions sensors or from pollution measurement sensors carried by vehicles. There are many technical issues related to measurement, including accuracy and calibration, but these are beyond the scope of this paper. The point to note is that CVIS could improve radically the data available on which to make policy decisions.

There is a great deal of technology development taking place in respect of vehicle powertrains. One aspect of CVIS is the provision of a “digital certificate” which enables a vehicle to describe its characteristics to an external system. One characteristic could be the vehicle’s emission profile and this could be used to allow, bar or differentially charge based on the type of fuel and the type and magnitude of emission.

3.6.2. CVIS and fuel efficiency

It is quite conceivable that CVIS can provide better and more timely information on the road ahead, for example gradient, curvature, presence of signals or junctions, combined with information on the behaviour of vehicles immediately ahead, e.g. speed, deceleration. Then the motive pattern of an individual vehicle might be optimised to minimise fuel consumption or emissions. Explicit policies on fuel use have been implemented but this has either been in response to an external crisis, such as lowering the national speed limit during a fuel supply crisis, or indirectly through traffic signal timings. It can also be a secondary effect from a safety or congestion management initiative, for example use of variable speed limits. CVIS could enable a more explicit and more sophisticated approach to implementation of a fuel conservation policy.

Airborne pollution has been a significant issue for many years and is particularly critical in some European cities, often exacerbated by weather conditions. Anti-pollution measures have generally been based on reducing the volume of traffic by strong measures such as total bans on private cars or only allowing vehicles with odd or even license plate numbers to use the roads on different days. In the first decade of the twenty first century the importance and potential impact of global warming has become widely recognised and the role of transport in producing greenhouse gas highlighted. This has changed the relative position of policies on emissions and pollution.

In overall terms the contribution of CVIS to environmental goals is probably fairly limited. The DfT study into the business case for CVHS (Department for Transport, 2005) took the view that the benefits were unquantifiable and probably small when set against safety and efficiency. However, at the time of that report the case for global warming was much less well accepted and the pressure to reduce emission of greenhouse gases was not as strong as it now is. Significant reductions in vehicle emissions are only going to come about through changes in engine technology and, more controversially, reductions in road travel.
CVIS can have a role to play in achieving environmental goals through supporting more efficient use of the engine and to make demand management measures more sophisticated. In the latter case it could be used to make pricing schemes more responsive to traffic conditions or to provide better managed and targeted access control schemes. In policy terms CVIS techniques may provide ways to address some of the publicly unpopular or undesirable effects of emission and demand management policies whilst allowing those policies to deliver on their primary objectives.

3.7. **Telecommunications**

3.7.1. **Spectrum allocation**

At the time of this report there is a significant amount of work underway to develop policy in respect of radio frequency spectrum management and allocation. In 2002 the European Union published the Radio Spectrum Decision (European Commission, 2002)) that sets up a framework for establishing and co-coordinating policy for the efficient use of the spectrum to support wider EU policy on jobs and growth as embodied in the renewed Lisbon Strategy. The Radio Spectrum Policy Group (RSPG) has been established with the mandate to provide advice to the Radio Spectrum Committee on issues of a broad policy scope beyond the technical measures that are usually the focus of such bodies.

One of the key areas being considered by these groups is the future policy on spectrum allocation. Conventionally, the spectrum is divided up into bands that have dedicated purposes or technologies with some bands being available for use by all without restriction ("unlicensed bands"). However, it is now acknowledged that this approach is not an efficient way to proceed as it creates resource limitations in what is an almost indefinite resource (in the sense that it cannot be “used up”). Work is underway to develop an approach to spectrum management based on an unlicensed model that supports service and technology neutrality. The project is called the Wireless Access Policy for Electronic Communications Services (WAPECS) (Radio Spectrum Policy Group, 2004). It is acknowledged that there may an overriding technical reason why there may need to be exceptions to this approach, but it is anticipated that these should remain the exception and that technical solutions using “spectrum plans” and “spectrum masks” that identify channels and set up power limits and guard bands.

This approach is now underway and there is a plan for it to be fully implemented by 2010. In the interim certain parts of the spectrum will be targeted to adopt this model within those bands in order to speed up development (Radio Spectrum Policy Group, 2004). The approach is considered to be a crucial factor in ensuring Europe retains its leading role in wireless technology and in supporting the i2020 component of the Lisbon agenda for growth and jobs in the EU.

The new approach to spectrum allocation is important for CVIS as it will remove several potential obstacles to deployment, in particular the divergent regimes for spectrum allocation that exist in different countries across Europe. For CVIS this new approach gives greater choice to the technology providers and strengthens the multi-network/network independence approach based on CALM. However, for the longer term when CVIS applications involve a
higher degree of control and hence have greater safety requirements there could be a justifiable need for protected access to specific frequencies. This means that the CVIS community needs to have in place structures that allow a harmonized approach and provide a route to engagement with bodies such as the RPSG and its technical equivalent, the Radio Spectrum Committee (RSC). However, the concept of the intelligent vehicle interacting with its surrounding through radio communications is identified explicitly as an area for further work by the Commission (European Commission Directorate General Information Society and Media, 2006). Presentations have been given to the RSPG on the requirements for road safety applications using CVIS (Ferriara, 2006).

3.7.2. Interference

The move towards an open market in spectrum use shifts the emphasis from regulatory protection (usually accomplished at a national level) to technology based management. Whilst the EMC directive (Directive 2004/108/EC) minimises unwanted and unintentional electronic interference there is a need to maximize use of spectrum by allowing services to co-exist within the same areas of the spectrum. Bearing in mind that certain parts of the spectrum will be more “popular” for particular applications because of technical characteristics, e.g. signal propagation characteristic, power requirements, antenna design, availability of low-cost components, there will be a whole range of mobile, personal services available on individual personal units sitting alongside CVIS.

The issue of the interaction between personal devices of people within vehicles is recognized as significant. The current situation on aircraft where the use of personal devices is restricted is seen as undesirable and would certainly not be expected or tolerated on buses, trains and particularly in private cars. That said, restrictions on the way in which mobile phones can be used in vehicles have had to be introduced because of evidence that the distraction has been a significant causal factor in road. Currently, restrictions have been placed on using handheld devices but there are concerns that the even calls on hands free sets may be unsafe. However these are matters concerning driver behaviour not the interaction in terms of communication systems.

The policy issue is that not only CVIS services but other mobile personal services must be able to co-exist safely within the same part of the spectrum. There will need to be a duty on all mobile service providers to work together to agree the required methods for avoiding interference and for managing any contentions that do occur. This includes relative prioritization of messages, use of alternative channels or frequencies for fallback in the case of a detected failure. To achieve this there will need to be a clear policy framework that sets out what must be in place to ensure safe operation of all services and this will involve both transport and communications services policy bodies.
3.8. **Privacy**

3.8.1. **Use of data for statistics**

Cooperative systems are intrinsically linked to collecting, exchanging and processing (big amounts of) data. This data in CVIS could be used for a big variety of purposes. For all storage and use of data, attention will be necessary for a sufficient guarantee of the individual privacy of the users. This is not only desirable from a moral point of view, but also required to be legally compliant.

This section first considers some possibilities CVIS could offer regarding data collection and use that were not mentioned before. Then it examines the international framework for privacy policy and relevant aspects for CVIS.

In section 3.1.4 it was noted that the extent to which CVIS penetrates the vehicle fleet may have a significant effect on the function and form of roadside data collection systems. The point was made that there are policy questions relating to individual privacy as well as the ownership and sharing of data. This was discussed in the context of real-time travel information, but not in the context of monitoring the statistics used for policy development and transport planning purposes.

CVIS provides opportunities to expand the richness of the available data particularly in respect of journey time and route information. The main policy question is whether there should be an obligation on those operating CVIS to provide such data to those bodies charged with developing long term transport policy and the planning and design of transport infrastructure. In any case provisions will be necessary to guarantee that these data cannot be linked to personal data. Cost will be a significant factor as CVIS operators may argue that the type of data, its storage and handling and meeting quality and privacy criteria increases the cost of implementing and running the system. For the organisation that wishes to access such data questions of value and affordability of obtaining the data are important. If data is being obtained from multiple sources then the data analysts are faced with coping with differences in data types, quality and time frames. This points to a need for agreed standards for expressing data and its quality.

3.8.2. **Use of data for enforcement of traffic regulations**

One of the more contentious possibilities that CVIS could offer is to radically change the way infringement of traffic regulations are identified and reported. The exchange of information between vehicle and infrastructure enables either the infrastructure to check the characteristics of the vehicles movement against the current regulations in force and identify if any transgressions have occurred and, if so, where and when they took place. Assuming the identity of the vehicle and its driver can be determined then some form of warning or enforcement action could be taken. The other way around is also possible, that is that the infrastructure system passes the details of the regulations to the vehicle and the in-vehicle systems monitor for any transgressions. Subsequently these can be reported back to the infrastructure.
Initially it is quite hard to conceive of the vehicle acting as “a spy” on the driver, but the tachograph, which does just that, has been accepted in the commercial transport sector for many years. Will this also be acceptable for other drivers, considering their privacy? The latest “pay as you drive” insurance products could also be seen in this light, as they report when the vehicle has been used in a “high risk” environment and that could include being driven in such a way as to break traffic regulations. At present this type of product is new in the market and there is no degree of compulsion for consumers to buy it if they are concerned about such issues. Unless it is very clear to the consumer who has access to this sort of information and what use they may make of it then, this aspect is unlikely to become widespread.

3.8.3. Framework for policy

Most countries have national legislation dealing with data privacy protection. Although there are differences from country to country, the general principles of data privacy and protection are often common. The *OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data* (OECD, 1980) and the *APEC Privacy Framework* (APEC, 2005) offer descriptions of such universal aspects of data privacy and data protection. In the *European Union Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and the free movement of such data* (European Commission, 1995) is mandatory.

Building on the documents from OECD, APEC and EU, a Technical Report from ISO (ISO, 2009) intends to provide guidance to developers of intelligent transport systems on general data privacy and protection aspects for the fundamental architecture and design of systems and implementations. The report “attempts to create the necessary nexus for intelligent infrastructure systems and provide for their implementation to the greatest extent possible”. The recommendations given in the report are in the form of a checklist of general principles, to be taken into account when developing systems.

An important part of these principles concern the relation between the collection of personal data and the purposes for which they are required. The Technical Report states that the purposes should always be well specified, explicit and legitimate and be determined at the time of the data collection. The data collected for these purposes should be adequate, relevant and not excessive. No further processing, use or disclosure of data should take place in a way incompatible with the original intention. Moreover, all personal data should be kept no longer than is necessary, for the reason for which they were collected.

The principles also concern the security of the personal data. Access to the data should be limited only to those persons who have “a demonstrable “need to know” “. “Acknowledging the risk that harm can result from misuse of personal information, specific obligations should take account of such risk”. The protection of the data should include “reasonable security safeguards against such risks as loss or unauthorized access, destruction, use, modification or disclosure”.

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3.8.4. CVIS and data protection

CVIS will provide a platform for the exchange of data among many actors, including drivers, road operators, service providers and traffic control centres. In principle the technical infrastructure for data exchange will not be limited to certain actors. Like the internet, it can be open for all actors who could make a useful contribution to the system and therefore be potentially vulnerable from many sides.

In many cases, the exchanged data in CVIS are personal data, in the sense that they refer or could be linked to private persons. In this context the eSecurity WG (SafetyForum, 2009) states, that “there is a long list of sensitive personal items calling for protection against, e.g.:

- establishment of personal motion pattern and tracking;
- loosing control over vehicle generated personal and personalised data, e.g. through directly or indirectly forced consent in using the named data by the owner/driver;
- desire of insurance companies, law enforcement bodies, authorities, private and criminal interest groups, to access all kinds of personal data (vehicle, driver behavior, health, social inclinations, etc.;
- purely commercial interests seeking to establish consumer profiles in context of business case development.”

In order to avoid misuse of systems like CVIS the European Data Protection Supervisor (EDPS) advocates an approach in which privacy issues are considered from the very beginning when defining the architecture of the systems (Hustinx, 2009). At an early stage the architecture of the system infrastructure should be determined as well as “the flows of data, the categories of data and the purposes for which they are used, the modalities of processing information, the retention period of data, the possible reuse of information and the role of the different actors within the envisaged system” (Buttarelli, 2009). Based on Directive 95/46, already mentioned before, and Directive 2002/58 (European Commission, 2002) on privacy in telecommunications the EDPS highlights a number of aspects particularly relevant in the context of developing Intelligent Transport Systems: data minimisation, anonymisation, security, interoperability, data quality, purpose limitation, security of data, responsibilities of actors, etc.

Considering the attention for privacy issues related to Intelligent Transport Systems, it is obvious that the policy on privacy has a substantial impact on system requirements for CVIS. Following the EDPS recommendations, privacy should be considered in all stages of development of the eventual architecture, operation and management of the applications and systems (“privacy by design”). This approach is also emphasised regarding the design of radio and telecommunications terminal equipment (European Commission, 1999). In this context the MINAMI project on mobile phones can be mentioned, in which a number of important principles were considered in relation to the application design, the platform design and required user evaluations (Ikonen, et al., 2008). A similar approach is possible regarding privacy principles and the various elements of CVIS. For example considering the principle of data minimisation and anonymity, one sees that in the CVIS-application Cooperative Network Management (CVIS subproject CURB) data from individual vehicles (current position and destination) is necessary to feed an Origin/Destination matrix. However, this data may be aggregated and anonymous at the central level (traffic volumes), so that all links with personal data can be cut.
Although much work is done on privacy, the eSecurity WG (SafetyForum, 2009) warns that a number of important issues are still unsolved. Regarding anonymity it mentions that the identity keys held by the control centres could be a weak link. Moreover, it states that still much is unclear about the position of the control centres, such as the legal status (public/private with consequences for the rules they are subject to), the guarantees for independency, the right to access data and the ownership of data, including the consequent scratching of data.

In addition, there is also the more fundamental question, whether it is desirable to guarantee anonymity in all cases and make that a part of the technical system. If vehicles are totally anonymous (and identities cannot even be tracked in the system), those involved in an accident and fleeing the scene may not be easily identified. This may be in conflict with policies on road safety and with policies on the security of civilians.

Setting aside fundamental questions about the right to security and civil rights, it seems obvious that if normal privacy principles are disregarded, there are high risks of misuse of the system. This may ultimately lead to loss of consumer trust. Even if much attention is paid to the privacy of the users, they may still have the perception they are at greater risk of being prosecuted for some form of transgression. In part this might come about through the policy mechanism used.

One way is to appeal to “civic duty” to provide information to a public sector pool accompanied by a guarantee of anonymity. Another route is to make it a civic obligation in return for some form or right, e.g. access to certain areas or lanes that provide some form of individual benefit or a fiscal incentive such as a discount on toll or parking charges. Obviously there are risks here of one policy incentive undermining another policy so careful consideration has to be given as to the overall effect. An alternative approach is to encourage the growth of “community” based services that collect and share information as part of a more altruistic arrangement but one that is not controlled by government at any level. From a policy perspective the attraction of the data collection and network monitoring side of CVIS is that it produces an outcome that can benefit the network as a whole.

Note that the degree of voluntariness, when choosing a route to implement CVIS, has important consequences for the way to deal with individual privacy. Is the system mandatory, then Directive 95/46/EC (European Commission, 1995) stipulates that there is a legal
framework taking into account all the required data protection principles. A system on a voluntary basis would require that users can freely give (and withdraw) their permission on using certain personal data. In a mixed system the user must be in the position to “switch-off” the voluntary services and features, that he chooses in addition to the mandatory part of the system.
4. Opportunities for policy delivery

4.1. Introduction

This chapter describes the results of an interactive session during a workshop with experts in the field of transport policy and cooperative systems¹. Inputs for this interactive session were the results of a broad inventory, based on literature review and described in the previous chapter, experience from the CVIS and SAFESPOT project and results from previous meetings with Polis. In the workshop the experts verified and added items to lists of new opportunities for policy delivery related to cooperative systems as well as potential negative effects and obstacles for the introduction. They also set priorities.

The following section addresses the preparation of the interactive session in cooperation with Polis and Safespot. Section 4.3 and 4.4 describe the results regarding new opportunities and potential negative effects for traffic management and traffic safety respectively. Section 4.5 deals with the obstacles for the introduction of cooperative systems that were discussed in the workshop. Section 4.6 gives an overview of the most important results.

4.2. Preparation of the interactive session

4.2.1. Input from POLIS

Polis is a network of European cities and regions working together to develop innovative technologies and policies for local transport. Polis has the role of training and dissemination partner within the CVIS project. The input of local and regional authorities was sought in relation to technologies and services that are being developed within CVIS. The project has a permanent dialogue with POLIS in order to share information on project progress and for consultation purposes at crucial stages in the project and on important topics. Polis and CVIS organize consultation and validation meetings:

- to exchange information about requirements, architecture and validated architecture and system requirements by, for example, preparing a session on the specific technologies and
- to advise at crucial stages or on important issues, e.g. in relation to system architecture, reference application and deployment aspects.

Before the workshop described in this chapter, two meetings with Polis took place, in which policy issues were discussed (Cré, 2006; Cré, 2007). The participants in these meetings were in general very positive about the potential of the technologies that are to be developed in the CVIS project in the way that these can be enablers for sustainable transport solutions. The

¹ Benefits of Cooperative Systems for Public Authorities (14 May 2009), Helmond, The Netherlands; a workshop jointly organised by POLIS, CVIS and Safespot.
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technology creates opportunities that need to be taken. However, the participants expressed a number of concerns as well, regarding the attention for:

– traffic safety;
– efficient movement of people and goods (too much focus on vehicles?);
– freight transport;
– public transport;
– multi-modality (supporting mobility chain, transfers);
– access restrictions;
– parking management in general and for specific target groups (e.g. mobility impaired people).

POLIS indicated (Polis, 2009) that “local authorities are moving towards the efficient movement of people and goods, rather than vehicles. They are interested in tools that can assist them in achieving their transport goals which are essentially about getting people out of their cars and into public transport and improving traffic efficiency for those vehicles that really need to operate on the roads, notably, public transport, emergency services, taxis and commercial vehicles. Thus, applications aiming at making the driving experience easier for private drivers are not necessarily in the main focus of local authorities. It is recognized that public transport as it is currently operated is very close to a cooperative system. This could be one of the quick win sectors for cooperative deployment.”

Regarding the roll-out of cooperative systems there were questions on:

– the use of CVIS-applications to solve specific local or punctual problems, without needing the complete massive investment;
– potential low cost and “quick-win” solutions;
– the introduction of the systems by taking CVIS applications on board one by one;
– the introduction of the system in addition to legacy systems;
– the penetration rate, necessary to see effects from the system;
– alternatives (low impact to the built environment) for necessary road side equipment;
– the combination of CVIS with systems for other purposes (e.g. satnav, tolling and pricing) and potential reduction of costs;
– the costs for the end-users.

Items from the meetings related to finance, legal issues and liability are not mentioned here, as there are separate deliverables from the CVIS project on these topics.
4.2.2. Round tables

In consultation with Polis, it was decided to discuss the subjects mentioned in the previous section in groups of about 10 to 15 people during an interactive session. In every group there was a moderator from the CVIS or Safespot project, a rapporteur and a person who wrote detailed minutes.

The task of the moderator was to introduce the subject, to indicate the scope of the discussion, to mention the relevant CVIS-applications regarding this scope and – based on the experience from the CVIS project – to present lists of items concerning:

– new opportunities for policy delivery;
– potential negative effects, which will need attention and
– obstacles to introduce cooperative systems.

The group members were expected to react on the information from the moderators (input from their own practice). They could express other views, add new elements to the discussions and mention priorities. The task of the rapporteur was to present the main findings to the other groups. In order to ensure that no information from the discussions got lost, in addition another member of the group made detailed notes.

Considering the list of subjects in the previous section, in consultation with Polis, four round tables were proposed:

A. traffic safety;
B. total traffic management;
C. freight and public transport and
D. improving traffic flows and access restriction.

Table 4.1 gives an overview of the proposed scope for every round table.

<table>
<thead>
<tr>
<th>Attendants of the workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td>About 50 persons attended the interactive session to investigate policy aspects related to cooperative systems. They included representatives from the following public organizations:</td>
</tr>
<tr>
<td>Azienda Trasporti Milanesi – Italy</td>
</tr>
<tr>
<td>Bast (Federal Highway Research Institute) – Germany</td>
</tr>
<tr>
<td>Belgian Road Research Centre – Belgium</td>
</tr>
<tr>
<td>CDV – Czech Republic</td>
</tr>
<tr>
<td>City of Dresden – Germany</td>
</tr>
<tr>
<td>Edinburgh City Council – UK</td>
</tr>
<tr>
<td>Flemish Government – Belgium</td>
</tr>
<tr>
<td>City of Hamburg – Germany</td>
</tr>
</tbody>
</table>
Table 4.1 Proposed round tables and scopes

<table>
<thead>
<tr>
<th>Round table</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic safety</td>
<td>– cooperative systems with the purpose to improve traffic safety</td>
</tr>
<tr>
<td></td>
<td>– cooperative systems with other purposes which effect traffic safety</td>
</tr>
<tr>
<td></td>
<td>– the (lack of) emphasis on traffic safety regarding cooperative systems</td>
</tr>
<tr>
<td>Total traffic management</td>
<td>– efficient movement of people and goods (rather than vehicles)</td>
</tr>
<tr>
<td></td>
<td>– traffic demand</td>
</tr>
<tr>
<td></td>
<td>– modal split</td>
</tr>
<tr>
<td></td>
<td>– route choice</td>
</tr>
<tr>
<td>Freight and public transport</td>
<td>– improvement of the quality and efficiency of public transport</td>
</tr>
<tr>
<td></td>
<td>– modal shift from private car to public transport</td>
</tr>
<tr>
<td></td>
<td>– improvement of the reliability and efficiency of freight transport</td>
</tr>
<tr>
<td>Improving traffic flows and access restrictions</td>
<td>– managing a given traffic demand on the road network</td>
</tr>
<tr>
<td></td>
<td>– restricting access to a sensitive or congested area (for certain types of vehicles)</td>
</tr>
</tbody>
</table>

After the registration of the attendants of the workshop, it appeared that very few were interested to take part in the round table discussions on the subject freight and public transport and the subject improving traffic flows and access restrictions. Roughly half of the attendants registered for traffic safety and half for total traffic management. In order to meet the preferences of the attendants the groups were changed, so that most of them could take part in discussions on their preferred subject. However, to avoid too big groups (not favorable for intensive discussions) and to obtain information from different points of view, the groups on traffic safety and total traffic management were split. For each subject one group considered the strategic level and one group the operational level:

A-1. traffic safety (strategic level);
A-2. traffic safety (operational level);
B-1. total traffic management (strategic level);
B-2. total traffic management (operational level).

Table 4.2 gives an overview of the scope for these groups and the most relevant cooperative applications from the CVIS and Safespot projects.
### Table 4.2 Adapted round tables, scopes and relevant applications

<table>
<thead>
<tr>
<th>Round table</th>
<th>Scope</th>
<th>Most relevant applications</th>
</tr>
</thead>
</table>
| Traffic safety - strategic level | – cooperative systems with the purpose to improve traffic safety  
– cooperative systems with other purposes which effect traffic safety  
– the (lack of) emphasis on traffic safety regarding cooperative systems  

_Ephasis on the strategic level: broad perspective, helicopter view, long-term measures and effects, …_ | – Monitoring and guidance of dangerous goods  
– Enhanced Driver Awareness (EDA)  
– Road conditions warning (SAFESPOT)  
– Vulnerable road user detection (SAFESPOT)  
– Collision warning (SAFESPOT)  

_many other applications with traffic safety components:_ |

| Traffic safety - operational level | – cooperative systems with the purpose to improve traffic safety  
– cooperative systems with other purposes which effect traffic safety  
– the (lack of) emphasis on traffic safety regarding cooperative systems  

_Ephasis on the operational level: daily control of a given traffic demand, short-term, …_ | – Cooperative Network management  
– Cooperative Area Routing  
– Cooperative Local Traffic Control  
– Cooperative Flexible Lane Allocation  
– Cooperative Traveller’s Assistance (CTA)  
– Parking zone management  
– Access control to sensitive infrastructures |

| Total traffic management - strategic level | – efficient movement of people and goods (rather than vehicles)  
– traffic demand  
– modal split | – CVIS cooperative monitoring (COMO): cooperative services for the monitoring of traffic and environmental status  
– Cooperative Urban Applications (CURB): cooperative services for the efficient use of urban road networks  
– Cooperative Inter-Urban Applications (CINT): cooperative services for the efficient use of inter-urban road networks |

| Total traffic management – operational level | – managing a given traffic demand on the road network by means of cooperative systems | – Cooperative Network Management  
– Cooperative Area Routing  
– Cooperative Local Traffic Control  
– Cooperative Traveller’s Assistance (CTA)  
– Access control to sensitive infrastructures  
– Cooperative Flexible Lane Allocation |

In consultation with the moderators, for each round table lists were prepared of new opportunities for policy delivery, as well as of potential negative effects, which will need attention, and obstacles for the introduction of cooperative systems. For a big part the lists of obstacles were based on the questions from POLIS on the roll out of cooperative systems (see section 4.2.1).
4.3.  Total traffic management

4.3.1.  Strategic level

Table 4.3 shows items that the moderator presented at the round table Total traffic management – strategic level. On the left one finds a number of new opportunities for policy delivery that will arise from the introduction of cooperative systems. On the right there are potential negative effects, which will need attention when introducing these systems.

<table>
<thead>
<tr>
<th>New opportunities for policy delivery</th>
<th>Potential negative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>– better information on traffic (real-time) influences traffic demand (people leave earlier, later or to other places)</td>
<td>– perception of “Big Brother” steering traffic</td>
</tr>
<tr>
<td>– better information on transport modes and parking facilities influences the modal split (use of public transport in congested areas)</td>
<td>– infringement of individual privacy</td>
</tr>
<tr>
<td>– better information on the road network influences the route choice</td>
<td>– too much private car oriented approach, because of focus on congestion</td>
</tr>
<tr>
<td>– traffic can be guided along safer roads and through less sensitive areas</td>
<td>– no improvement, because CVIS will lead to extra traffic (latent demand)</td>
</tr>
<tr>
<td>– more efficient use of the road network can make space for public transport, freight, etc.</td>
<td>– potential conflicts between individual travel improvement and network optimization</td>
</tr>
<tr>
<td>– cooperative intersection control will increase traffic safety</td>
<td>– cooperative lane allocation will increase capacity</td>
</tr>
</tbody>
</table>

In order to get an indication what items are the most important and focus the discussion on these items, every member at the round table was given three votes. One vote for new opportunities, one for potential negative effects and one free to use either for new opportunities or potential negative effects.

The following new opportunities were selected:

1. Better information influences the modal split (6 votes);
2. Efficient use of infrastructure gives space for public transport, freight and non-motorised transport (4 votes);
3. Better information influences travel demand (3 votes);
4. Better information influences the route choice (2 votes).
The participants stated that the word “better” in the descriptions should stand for improved quality: more accurate and reliable.

The following potential negative effects were selected:
1. Too much car oriented approach (7 votes);
2. Conflicts individual travel improvement and network optimization (2 votes).

Figure 4.1 visualizes the results of the selection: the selected new opportunities for policy-delivery on the right and the potential negative effects on the left. The sizes of the half circles on the right and on the left symbolize the difference in the number of votes for new opportunities and potential negative effects (more emphasis on new opportunities). The size of the segments per half circle corresponds with the number of votes per item.

The perception of the group is that CVIS applications focus on improving the circulation of private cars (item voted the most). The participants mention e.g. the bus-lane application, which allows private cars to use the bus-lane. It provides extra road space to cars, in this way creating conditions for extra private vehicles to enter and circulate in the city, while other modes of transport do not benefit. This seems to be in contradiction to current town policies on promoting other transport modes in cities, like public transport, bicycles and pedestrians.

The members of the round table discussion stress that CVIS technology should not be contrary to current transport policy, but CVIS-tools should support the implementation of this policy. They consider it as positive, if cooperative systems are able to create extra space for public transport, freight and non-motorized traffic (4 votes). They also mention applications to give priority to certain traffic and speed advice, which can contribute to reach
environmental goals. CVIS-applications could minimize the number of stops of (heavy) vehicles and unnecessary accelerations, in this way optimizing fuel use and emissions.

Witness the voting in the group, the members appreciate the added value of cooperative systems even more, when thinking of accurate and reliable information on road traffic conditions. Better information on current (and predicted) road traffic conditions can improve pre-trip and on–trip information for travelers of all modes. The members see important advantages regarding the modal split (6 votes), especially the use of public transport, as well as for the traffic demand (3 votes).

In order to elaborate the system’s potential regarding these items, the group recommends to involve public transport stakeholders in the further development. Specific public transport oriented CVIS applications should be developed. Furthermore they recommend a broader dissemination of the potential benefits of cooperative systems, so that a bigger group of transport professionals will be reached.

Although the group shows a critical attitude towards the CVIS applications, especially regarding the private car orientation, the overall result of the selection of items was found to be positive. Group members put more emphasis on the new opportunities for policy delivery (15 votes) than on potential negative effects (9 votes).

### 4.3.2. Operational level

Table 4.4 shows the items presented as input at the round table Total traffic management – operational level. Group members were asked to select items in the same way as for the strategic level. This resulted in the selection of the following three new opportunities for policy delivery:

1. better traffic guidance to roads with available capacity (9 votes)
2. use of narrow lanes / smaller headways (4 votes)
3. better use of designated lanes (by other traffic) (2 votes)

The participants see it as a very important advantage that cooperative systems show “where the vehicles are”. Using this data, traffic centers are able to guide the traffic in a better way and optimize the use of the road network. To find an optimum it is important to seek for a good balance of traffic network-wide. One should prevent that all traffic is sent to second best routes, resulting in problems on those routes while the “best routes” are not used to their capacity.

A debatable question is, whether the private sector can take the role of distributing the traffic over the network. In practice already now, private companies delivering navigation equipment, influence the distribution. However, there are differences in interests between the private sector and the public sector. Commercial interests of private companies do not automatically lead to the optimal network use that public authorities would like to see.

The use of narrow lanes/smaller headways is not a part of the demonstrations of the present applications in the CVIS project. Nevertheless by applying cooperative systems it will be technically possible to use more narrow lanes and smaller headways, resulting in an increase
of capacity. The members of the group see the advantages of such developments (4 votes), although none of the members selected this item as the first choice. The group indicated that such applications could only be effective, if many of the vehicles dispose of the equipment required. Only then, special lanes could be made for these vehicles.

The item “better use of designated lanes (by other traffic)” was selected by two of the members of the group. One member mentioned the advantages of the use of designated lanes in case of working on the roads in big towns. Working on roads in Prague led to important congestion, on which a better use of designated lanes may have had a positive influence.

The participants selected five potential negative effects from the list as the most important, of which three are dominant:

1. liability for system failure unclear (6 votes)
2. a restriction to certain routes is difficult to enforce (4 votes)
3. guidance of traffic through sensitive areas (4 votes)
4. guidance of traffic along roads with high accident risks (1 vote)
5. drivers do not trust the automatic system (1 vote)

<table>
<thead>
<tr>
<th>New opportunities for policy delivery</th>
<th>Potential negative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>better traffic guidance to roads with available capacity</td>
<td>guidance of traffic along roads with high accident risks</td>
</tr>
<tr>
<td>restriction of certain traffic to pre-determined routes</td>
<td>guidance of traffic through sensitive areas</td>
</tr>
<tr>
<td>better use of designated lanes (by other traffic)</td>
<td>a restriction to certain routes increases the costs of transport</td>
</tr>
<tr>
<td>use of narrow lanes / smaller headways</td>
<td>a restriction to certain routes is difficult to enforce</td>
</tr>
<tr>
<td></td>
<td>broader use of bus-lanes: less priority for public transport (?)</td>
</tr>
<tr>
<td></td>
<td>“non-certified” use of bus-lanes brings system into disrepute</td>
</tr>
<tr>
<td></td>
<td>broader use of bus-lanes: difficult to enforce</td>
</tr>
<tr>
<td></td>
<td>other traffic cannot exit the bus-lane, if necessary</td>
</tr>
<tr>
<td></td>
<td>serious accidents in case of use of narrow lanes/smaller headways</td>
</tr>
<tr>
<td></td>
<td>drivers do not trust the automatic system</td>
</tr>
<tr>
<td></td>
<td>liability for system failure unclear</td>
</tr>
</tbody>
</table>
The participants added one item to the list:
– bigger side-effects of accidents

“Liability for system failure unclear” is the item selected the most (6 votes). The group discussed the risks for road operators to introduce systems, if there is a substantial risk of breakdown. Such breakdowns might also lead to bigger accidents (and side-effects) than there would be without the systems. Road operators try to limit risks and will avoid such systems. On the other hand the introduction of the Internet was mentioned. This system did not work perfectly either; nevertheless it was introduced. However, malfunction of the Internet cannot lead to casualties in the same way as a breakdown of roadside equipment can.

The biggest problem is maybe not the liability itself, but the uncleanness of the liability. If it would be clear who is responsible for what, probably a big part of the problems would be solved. A complicating factor in this, are the boundaries of the cooperative system. They cannot be well defined.

To enforce the restriction of traffic to certain routes effectively, by means of cooperative systems, legislation should be adapted. Technically it is possible that on-board units send a message when drivers do not respect the rules regarding the restriction to certain routes.

Figure 4.2 visualizes the results of the selection done by the group discussing total traffic management at the operational level. In the same way as in figure 4.1, this figure shows the selected new opportunities for policy delivery and potential negative effects.
Looking at the overall results of the discussions about the operational level, it is evident that better opportunities to guide the traffic is seen as the most important advantage of cooperative systems. However, the improved opportunities to guide the traffic give authorities the responsibility to make good use of this. Authorities have to make sure that the traffic guidance is high standard, avoiding negative effects to sensitive areas or safety. Maybe even more important than this are concerns about the liability, legislation and enforcement. Considering the voting in the group, totally the concerns (16 votes) and new opportunities (15 votes) are approximately in balance.

4.4. Traffic Safety

4.4.1. Strategic level

Table 4.5 shows the items presented as input at the round table Traffic Safety – strategic level.

<table>
<thead>
<tr>
<th>New opportunities for policy delivery</th>
<th>Potential negative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>− better (real-time) information for road-users on risks on the road</td>
<td>− perception of “Big Brother” checking all traffic</td>
</tr>
<tr>
<td>− better information for authorities on accidents and their causes</td>
<td>− infringement of individual privacy</td>
</tr>
<tr>
<td>− better information for road maintenance (skid resistance)</td>
<td>− risk compensation</td>
</tr>
<tr>
<td>− guiding traffic along safer roads</td>
<td>− system failures</td>
</tr>
<tr>
<td>− guiding traffic in case of incidents and accidents</td>
<td>− drivers do not feel responsible</td>
</tr>
<tr>
<td>− avoiding unnecessary traveling</td>
<td>− drivers will get an overload of information</td>
</tr>
<tr>
<td>− safer roads because of less congestion</td>
<td>− drivers will try to “trick the systems”</td>
</tr>
<tr>
<td>− safer roads because of good network control</td>
<td>− drivers will be guided along roads with higher risks</td>
</tr>
<tr>
<td>− better enforcement by means of automatic reports to authorities</td>
<td>− differences road signs / in-car information complicates enforcement</td>
</tr>
<tr>
<td>− limiting unsafe behaviour of drivers</td>
<td>− geographical roll-out of the system</td>
</tr>
<tr>
<td>− better opportunities to focus traffic safety policy</td>
<td>− differences among countries</td>
</tr>
<tr>
<td>− better opportunities to deal with specific black spots</td>
<td>− system technologically outdated because of slow roll-out</td>
</tr>
<tr>
<td>− cooperative safety systems are a new responsibility for road operators</td>
<td></td>
</tr>
<tr>
<td>− safety will be a new priority for road operators (besides throughput)</td>
<td></td>
</tr>
</tbody>
</table>
After the presentation of the items by the moderator, the group decided to add an item to the list with opportunities:

– Cost efficiency for operations

The argument for adding this item is the relatively easy way to measure cost efficiency for operations by means of using cooperative systems, while measuring effects on traffic safety is complicated, as safety is based on individual incomparable events. In general accidents are a result of a multitude of circumstances. Cooperative systems could provide more specific information on the circumstances leading to accidents and on the effectiveness of measures for prevention.

After adding the additional item, the group members selected the following new opportunities as the most important:

1. cost efficiency for operations (4 votes);
2. safer roads because of less congestion (3 votes);
3. limiting unsafe behavior of drivers (2 votes)
4. safer roads because of good network control (1 vote).

The group discussed the importance of improving traffic safety in comparison with reducing congestion. Some members of the group argued that in a number of countries the traffic safety targets already have been met. They suggested focusing the CVIS targets on reducing congestion, while others attach great importance to improving traffic safety. Policy goals on traffic safety (and congestion) differ per country. Although in general traffic safety is important in all of Europe, the significance differs depending on the situation of the road infrastructure and traffic.

The group selected the following potential negative effects as the most important:

1. Drivers do not feel responsible (2 votes);
2. Drivers will get an overload of information (1 vote);
3. System failures (1 vote);
4. Perception of “Big Brother” checking all traffic (1 votes);
5. Infringement of individual privacy (1 vote);
6. Differences among countries (1 vote);
7. System technically outdated because of slow roll-out (1 vote).

Members of the group are concerned that too much confidence in the systems could lead to less attention of the driver and carelessness. There are also concerns about an overload of information in the car. This could lead to neglecting the surroundings and the traffic on the road. The group thinks, it is essential to prioritize in car information.
The group added the item:
– (re)liability

The group raised the question: “Who has the final responsibility in case of accidents due to wrong information?” Is the driver responsible or the road operator (or service provider) who may have delivered inaccurate information? The group suggests to distinguish three types of stakeholders and to examine and define in detail what responsibilities these stakeholders have. The stakeholders distinguished are: individuals, drivers and road (traffic) managers.

Figure 4.3 visualizes the results of the selection done by the group discussing traffic safety at the strategic level. In the same way as in the previous section on traffic management, this figure shows on the right the selected new opportunities for policy delivery and on the left potential negative effects.

![Figure 4.3 Visualization of workshop results: traffic safety, strategic level]

Looking at the overall result of the selection of the items, one sees that the group selected slightly more new opportunities (10 votes) than potential negative effects (8 votes). The group sees advantages of the introduction of cooperative systems, especially regarding cost efficiency of operations, while potential negative effects are mostly related to liability, privacy, system failure and the human interface of the systems.

4.4.2. Operational level

Table 4.6 shows the items presented as input at the round table Traffic Safety – operational level.
### Table 4.6 Traffic Safety (operational level)

<table>
<thead>
<tr>
<th>New opportunities for policy delivery</th>
<th>Potential negative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>information on <strong>hazards beyond the range of vehicle sensors</strong></td>
<td>perception of “Big Brother” checking all traffic</td>
</tr>
<tr>
<td>automatically <strong>keeping safe distance</strong> between vehicles</td>
<td>infringement of individual <strong>privacy</strong></td>
</tr>
<tr>
<td>broadcasting the <strong>vehicle’s presence</strong></td>
<td><strong>risk compensation</strong></td>
</tr>
<tr>
<td>better <strong>information on the current speed limit</strong></td>
<td><strong>system failures</strong></td>
</tr>
<tr>
<td>setting <strong>speed limits according to circumstances</strong></td>
<td>drivers do not feel <strong>responsible</strong></td>
</tr>
<tr>
<td>more effective safety measures at <strong>black spots</strong></td>
<td>drivers will get an <strong>overload of information</strong></td>
</tr>
<tr>
<td><strong>better monitoring of dangerous transport</strong></td>
<td>drivers will try to “<strong>trick the systems</strong>”</td>
</tr>
<tr>
<td>early detection of <strong>wrong way drivers</strong> (&quot;ghost drivers&quot;)</td>
<td>drivers will be <strong>guided along roads with higher risks</strong></td>
</tr>
<tr>
<td><strong>early detection of accidents</strong></td>
<td>potential <strong>differences among regions</strong> (because of roll-out)</td>
</tr>
<tr>
<td>safety will be a <strong>new priority</strong> for road operators</td>
<td>potential <strong>differences among countries</strong></td>
</tr>
<tr>
<td></td>
<td>use of <strong>technologically outdated systems</strong></td>
</tr>
</tbody>
</table>

The group selected eight of the new opportunities as the most important:

1. setting speed limits (or advice) according to specific circumstances (2 votes)
2. more effective safety measures at black spots (2 votes)
3. informing the driver about hazards beyond the range of vehicle sensors (1 vote)
4. avoiding head-tail collisions by automatically keeping safe distance between vehicles (1 vote)
5. broadcasting the vehicle’s presence (1 vote)
6. better monitoring of dangerous transport (1 vote)
7. early detection of wrong way drivers (1 vote)
8. early detection of accidents (1 vote)

Two of the items were selected by two members, the other items only by one member. However, the group stressed that this does not mean that there is a ranking of the items.

The group selected six items as the most important potential negative effects of cooperative systems deployment:
1. system failures will lead to unsafe situations (4 votes)
2. infringement of individual privacy (2 votes)
3. potential differences among regions (2 votes)
4. potential differences between countries (1 vote)
5. drivers will try to “trick the systems” (1 vote)
6. drivers will get an overload of information (1 vote)

Within this group of issues “system failures” was ranked most important.

Figure 4.4 visualizes the results of the group who discussed traffic safety at the operational level. The most striking in this figure are the big number of items mentioned by the group without much emphasis on certain items, especially regarding the new opportunities for policy delivery.

![Figure 4.4 Visualization of workshop results: traffic safety, operational level](image)

During the discussion the group focused on the potential negative effects.

**System failures**

System failures might lead to unsafe situations when the driver is not aware that the system fails. In the development of the CVIS system, the problem of system failures was addressed at the design level (as part of overall architecture). It can easily be designed fail-safe and avoid wrong (vicious) messages. However, in the group doubts were raised whether the system will
be 100% fail-prove when deployed on the large scale. Many networks and autonomous parts are involved and there are doubts whether a decentralized system like this can be fail-safe. Could a small failure in parts of the system lead to a complete failure?

Field operational tests (FOTs) on a large scale are necessary to analyse what happens in case of failures. However, there is uncertainty whether all potential failure situations can be tested in FOTs.

A back-up system will be necessary and more emphasis should be put on demonstrating to the relevant deployment stakeholders (in particular public authorities) that system failures can be handled (if they occur) and that this will in no case lead to situations where the public authorities can be held responsible for driver behaviour. One option is creation of a “restoration fund” (in case of system failure) that puts everyone at ease.

The system should be deployed in a way where the CVIS safety messages are considered as a bonus to something else. The driver remains responsible. All information provided is only additional assistance to the driver. One example for this principle is traffic management systems. If the system fails the traffic lights still work. Thus, safety is never compromised, only additional benefits such as green waves are lost.

Drivers have become accustomed to depend on systems. If they receive no warning they consider themselves safe (reduced attention threshold). The next generation of drivers (active from 2020) should get compulsory training on these issues.

**Potential differences among regions**

The group does not consider differences among countries as an issue. The members of the group think EC directives and CEN standards will result in sufficient harmonisation. However, regional differences (caused by gradual roll out of systems) are an issue. E.g. in the UK there are about 150 highway authorities of which some 20 show an innovative, pioneering approach.

Political agendas make all the difference (and reduced budgets with big competition between regions on state funding). The UK used to top the lists of safest roads. Now this position is at stake. This brings about a new strategy (vision zero). Some of the CVIS (and Safespot) applications can be useful towards the goal of zero casualties. However, to be effective neighbouring regions have to cooperate.

The interoperability of the system has been tested between Safespot and CVIS. But real interoperability across countries will only be achieved, if the driver can receive the messages always in his preferred language. 80% of air accidents are caused by human error – 30% of them because of the pilot’s language barrier.

**Privacy issues**

In the period in which the workshop took place, the UK media talked about CVIS as “Big Brother” in an article about the involvement of the UK government in the project (Lewis, 2009). And yet, members of the group argued that the UK is full of electronic detection systems (CCTV, LPR, etc.). Citizens are used to being scrutinized. The group thinks, it is no real issue, the benefits far outweigh the burden. In accident reconstruction systems, the last
minute before the crash is broken down into tiny details – all the information is made available. However, the UK in general is less sensitive to privacy issue. For other countries (e.g. France, thinking about the privacy discussions related to the introduction of an electronic ticket system for public transport) this could be a more relevant barrier for deployment.

Looking at the overall results of this group, one sees that the group mentions a big number of advantages of the implementation of cooperative systems, without selecting any specific items as the most important to improve traffic safety. The group seems to expect positive effects from cooperative systems on traffic safety over a wide range. In contrast with the new opportunities, among the potential negative effects the group sees a clearly dominant item, “system failures” that will need full attention. Considering the voting in the group, the new opportunities (10 votes) and the potential negative effects (11 votes) are approximately in balance.

4.5. Obstacles for the introduction of cooperative systems

4.5.1. List of obstacles

For all groups discussing traffic management and traffic safety the same list of obstacles for the introduction of cooperative systems was prepared. For a big part this list of obstacles was based on questions from meetings with POLIS (see section 4.2.1). In addition there are items from the surveys carried out among road operators (CVIS project, topic 4). Furthermore, in cooperation with the moderators of the groups discussing traffic safety, one extra item was added (only for the groups addressing traffic safety).

In every group the members were asked to rank the items in the list. The item that they consider the most important gets three votes, the second important two votes and the third important one vote.

Table 4.7 shows the list of obstacles that was used as input for the discussions. In addition there are a number of items that each individual group added during the discussions. This table also shows the results of the ranking in all four groups. The gray or coloured squares show the items that were selected, including the number of votes. The colours show the ranking per group: red the items with the most votes, orange the second most votes and yellow the third most votes.

In table 4.7 the two items the most stressed (by all groups) are:

– massive investment for total system and
– lack of cooperation among the stakeholders

| Table 4.7 Obstacles for the implementation of CVIS | 04/02/2010 | 64 | Version 2.8 |
These two obstacles seem clearly to be considered more important than other items. Most of the groups rank them among the two most important items.

From the other obstacles the items “the penetration rate” (of the system) and “legislation” were selected the most often. One item in the list, “other solutions” (to achieve the goals of cooperative systems), gets very little emphasis (one vote in only one group). This indicates that there do not seem to be good alternatives for cooperative systems.

From the items, which were added during the discussions (at the bottom of table 4.7), “liability” was mentioned by two groups. The group Traffic Safety – strategic level added the item “benefits unclear”. This group ranked this item also as the most important.

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<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Group Traffic management</th>
<th>Group Traffic Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>items presented</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– massive investment for total system</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>– present (legacy) systems</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>– the penetration rate</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>– other solutions</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>– introduction separately from tolling and pricing systems</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>– costs for the end-user</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>– lack of cooperation among the stakeholders</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>– legislation</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>– users are not interested</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>– one big accident causing a complete stop of the services *)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>items added</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– overload of in-car devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– liability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– lack of clear business case for every sector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– benefits unclear</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>– reliability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– lack of services</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*) Presented in the groups discussing traffic safety
Figure 4.5 gives a visualization of the results of the selection of all four groups. Because all results are put in one figure, this figure may look complicated at first glance. Every quadrant of the circle gives the results of one group: on the right up from the group working on traffic safety at a strategic level, on the right down from the group working on traffic safety at the operational level, etc. The colours correspond with certain obstacles, while the same colours are used for all groups, e.g. dark green for “lack of cooperation” and brown for “legislation”. The surface areas per quadrant correspond with the percentage of votes given by the group. The total impression one gets from the coloured areas gives an indication of the (relative) importance of the obstacles.

In the figure one can see that there is a relatively big area of dark green in almost all the quadrants. This corresponds with the selection of the obstacle “lack of cooperation” by all four groups. The light yellow area corresponds with “massive investment for total system”, which is large in three of the four quadrants.

![Figure 4.5 Visualization of indicated obstacles for the implementation of CVIS](image)

**4.5.2. Investments**

Three of the four groups selected “massive investment for total system” as an important item. Two groups gave it the most votes and in one group this item was at the second place. It might be surprising that one group (Traffic Safety – strategic level) did not select this item at all. However, one has to keep in mind, that in this group the discussions focussed at the benefits and the balance between costs and benefits. As mentioned before, this group ranked the uncleanness of benefits as the most important obstacle.
The perception of most of the workshop participants is, that the CVIS technology and application implementation is very expensive. Nevertheless one group (Traffic management – operational level) mentioned that “massive” is not a good word for it. This group preferred the word “big”.

In almost all groups the discussion on the costs focussed on how to introduce systems in the best way, regarding the big investments that takes. One group (Traffic management – strategic level) discussed the opportunities of using cooperative technologies and applications to replace current data collection systems. In this way, saving costs of current systems. Showing that cooperative technologies also save costs, this group considers a good approach for promoting the introduction.

In general it will be necessary to quantify all benefits (better information, improved safety, improved traffic flow, cost reduction and less maintenance) in order to convince policy makers on the effectiveness of cooperative applications. Public authorities are considered as the stakeholder that should do a first step regarding the investments. They should start building the infrastructure. However, public authorities do not want to (cannot) invest public money without a clear business case.

A clear business case could be a base for the successful roll out of the system. Consider the investment in mobile phones 15 years ago. A clear business case helped the roll out substantially even though the public was sceptical in the beginning (“I’ll never use this stupid thing”). However, cooperative systems focussing on safety might be even more difficult to sell. The advantage of having a safety system is not that clear to everybody. Citizens do not feel individually concerned: “only the other ones get involved in an accident”. Surveys indicate that road operators fear to be alone to invest in cooperative systems, without vehicle manufacturers and other stakeholders to back them up (afraid of lack of cooperation). Besides this the needed investment itself causes problems. Investments cannot be done at the same time as road maintenance activities but rather need to be done on a short to middle term basis in order to achieve a significant roll-out (for example, in the UK, residential roads on average are only new surfaced every 25 years).

Also the life cycle of systems is important. If road-operators invest in certain roadside equipment, in general this equipment will be used until the end of the life cycle. In this period the functionalities of the systems are mostly fixed. In order to do optimal investments, road operators need information on future developments, so that they can anticipate and focus in a good way.

4.5.3. Cooperation among stakeholders

All groups selected “lack of cooperation among stakeholders” as an important obstacle for the implementation of cooperative systems. One group ranked it as the most important item and two groups as the second most important (see table 4.7 and figure 4.5). The group Traffic management – strategic level did not rank it among the first three items.

At the operational level there seems to be more attention for this subject than on the strategic level. At the operational level this items gets the most votes (traffic safety) or almost just as many votes as the most selected item (traffic management: 15 in comparison with 16). At the operational level people might be faced more directly with problems related to a lack of cooperation than at the strategic level.
One group (Traffic management – operational level) discussed the cooperation among road operators. Cooperation among road operators at a national level (at least) is essential for good traffic management. The workshop participants stress that practice has shown that such a cooperation is not easy to establish. Looking at other stakeholders such as car manufacturers and telecom-companies, cooperation at an international level is necessary which may be even a bigger challenge.

Sharing data might be a way to stimulate cooperation. Satellite navigation systems are used on the market without local authorities providing much data. If authorities would provide accident data, service providers might take this up and develop it into services. This could push the roll out of the system. Public private partnership is needed. For example, in Italy 90% of roads are public/private. Data access is free, but the operator must provide various services. However, inconsistencies across Europe will not make this happen in all countries (e.g. unlikely for the UK).

4.5.4. Other obstacles

Looking at the other obstacles presented, the workshop participants selected “the penetration rate” (of the system) and “legislation” the most often. The groups focusing on traffic management seem to consider the penetration rate more important (second and third most important item) than the groups looking at traffic safety. This might indicate that there is the perception that even in case of a low penetration rate, cooperative systems could be useful for traffic safety; more useful than for the total traffic management. Specialized applications to improve traffic safety (focusing on certain road-user groups) are conceivable.

The item “legislation” was mentioned by three of the four groups. Two groups ranked it as the third most important. The groups looking at traffic safety seem to see legislation as a more important obstacle than the other groups. Traffic safety specialists might be more aware of the complexity of legislation in relation to new developments, as they are faced with legislation more directly (laws related to drivers, vehicles and infrastructure).

4.6. Discussion of results

Based on literature review the previous chapter gives an overview of the broad impact that can be expected from cooperative systems on a wide range of policy areas. The interactive session confirms this broad impact. The participants of the workshop indicate that cooperative systems can have important impacts regarding the policy on traffic management, traffic safety, environmental issues and privacy. The workshop participants expect many positive effects from cooperative systems. As well as for traffic management as for traffic safety, they indicated that such systems could give new opportunities for policy delivery. The systems could reinforce the implementation of present policies, but might probably also help to achieve (even) more ambitious policy goals. On the other hand there are also potential.
### Figure 4.6 Moments to support the traveller, activities corresponding with policy-goals, cooperative services at a conceptual level and CVIS applications
conflicts within and between certain policy-areas, which were found in the workshop and which need attention when introducing systems

4.6.1. New opportunities for policy delivery

Cooperative systems influence the whole chain of travelling, starting with the decision to make a trip, the choice of the moment of travelling, the choice of the mode of transport, etc. to the reaction on circumstances during the trip to avoid accidents and the reporting of incidents. Figure 4.6 gives an overview of this chain, including a number of activities to achieve transport objectives that are quite common in Europe, services that could support the policy objectives and CVIS applications relating to these.

It is expected that the use of cooperative systems can lead to a substantial improvement of the opportunities to guide the traffic on the road network (see figure 4.7). This is including opportunities to give priority on the road network to public transport and other sustainable types of transport, as well as freight transport. Cooperative systems could lead to a more optimal use of the network and a more efficient use of resources. In addition to applications of cooperative systems, specifically aimed at road safety, it is expected that the optimal use of the road network (less congestion) will go together with a contribution to policy goals regarding road safety (see figure 4.8).

To a certain extend optimizing the use of the road network will also go hand in hand with aiming for environmental policy objectives. A decrease of congestion could result in a more effective fuel use and fewer emissions. Measures to avoid stops at intersections – especially for heavy vehicles – (green waves depending on the traffic flow and it’s composition) could strengthen these effects (decreasing fuel use for acceleration), as well as systems, which could assist drivers to find parking space (avoiding driving extra kilometres to find a parking).

In addition to the opportunities regarding the use of the existing road network, cooperative systems are expected to be a useful tool for policies on influencing traffic demand and the modal split. Cooperative systems will make it possible to provide more reliable and up-to-date traffic information. By using this information people will have the opportunity to make better decisions on whether they want to make the trip (or choose an alternative destination, if possible) and at what time they will do the trip (spreading the traffic demand). Moreover, travellers can be better informed about all modes of transport or combinations of modes of transport, in this way supporting policies to increase the use of public transport and intermodal transport.

4.6.2. Potential conflicts in policy-delivery

Besides new opportunities also potential conflicts within and between certain policy-areas can be derived from the workshop results. The following list gives an overview of some important findings.

– Transport policy: balance in policy

The CVIS-project works on the development of the technical infrastructure to exchange information among cars and the roadside. In the project a number of applications are
Figure 4.7  Total traffic management: new opportunities for policy delivery and potential negative effects, indicated at the round tables strategic and operational level

Figure 4.8  Traffic safety: new opportunities for policy delivery and potential negative effects, indicated at the round tables strategic and operational level
proposed and tested on site. The majority of the applications in CVIS are applications to be used in private cars. This might give the impression, that cooperative systems are tools only to promote the use of passenger cars. This would be in conflict with present transport policies, which generally try to stimulate the use of sustainable transport modes, such as public transport.

The platform to exchange information in cooperative systems could be a useful tool not only for passenger cars, but for the complete field of transport policy. In order to make cooperative systems contribute to a well-balanced overall transport policy, it is important to pay sufficient attention to these systems in relation to all modes of transport.

- **Traffic management: individual optimization and network optimization**

  Road operators try to optimize the use of the network. In case of congestion on a certain road section, the road operator will try to guide the traffic around the congested section. Often such a re-routing is also in the interest of the road-user. But what about situations, in which road operators want to send a part of the traffic along a longer route to avoid congestion at the total network? Is it acceptable that a part of the road-users have negative effects for the benefit of all road-users? To what extend? And is it possible to distribute the traffic in such a way, looking at the stakeholders involved? Road-users can use route information from road operators, but also from (other) private providers. Effective policies on road network optimization call for broad (public/private) cooperation of all providers of routing information.

- **Traffic safety: overall effects not sufficiently clear**

  In general the workshop participants expect that cooperative systems will have positive effects on traffic safety. However, not all effects are clear yet. Further research will be necessary to get more certainty about the expected overall effects on safety.

- **Traffic safety: guiding traffic along alternative routes that are less safe**

  To optimize the traffic flows on the total road network (a part of the) vehicles may be sent along routes, which are not suitable for big amounts of traffic. These routes may be less safe than the normal routes. On the other hand congestion on the normal route will also have a negative influence on traffic safety. When developing policies on the optimization of the use of road network, all such effects should be balanced in the right way.

- **Environmental policy: guiding traffic along alternative routes that are not suitable**

  Alternative routes, along which traffic is guided to optimize traffic flows, may be less safe than normal routes; they also may be more sensitive regarding the environment (noise, emissions). Also these environmental effects are important aspects to include in policies on network optimization.

- **Enforcement: in-car information not clear to other road-users**

  In theory cooperative systems could make it possible to follow all movements of cars. This would make enforcement an easy task. However, it is debatable whether such a way of enforcement will be acceptable (see also the point on privacy). When considering the current practice of enforcement, in-car information may make the implementation of policies on enforcement more difficult. If for instance a clearance to use a bus-lane only appears in-car, other road-users may see the use of the bus-lane as an offence, which is not penalized. This may undermine policies on enforcement.
Guidelines for Policy Makers

– Privacy: use of private information

Cooperative systems process much information, among which also private information about the road-users. Attention is needed to guarantee that the information, that the system collects and files, is in balance with the purpose for which it is used and that it is sufficiently protected, so that third parties cannot misuse it.

Note that a part of the aspects mentioned are not exclusively related to cooperative systems. If for example traffic is guided along alternative routes by traditional means, also questions arise about how to optimise the use of the road network, considering capacity, traffic safety and environmental issues. However, cooperative systems will make it easier to re-route traffic, leading to more substantial effects. This makes it more important to develop policies that can be a base for the decisions at the operational level.

The importance and multitude of impacts CVIS can have on several policy areas and the potential conflicts among policy-areas creates a major challenge to develop a coherent policy. The obstacles for the introduction of CVIS, which were identified during the workshop, also reflect this. The obstacle “lack of cooperation”, which the participants selected the most, also calls for a coherent policy on a broad policy-area. This, in such a way, that it will stimulate the cooperation among the very diverse group of stakeholders that is involved in cooperative systems.

The findings from the workshop described in this chapter are input for a number of interviews with key policy-makers/advisors from several EU-countries and for a questionnaire distributed among policy-makers/advisors from all EU-countries. The next chapter deals with the findings based on the interviews and the questionnaire, leading to a number of recommendations for policy described in chapter 6.
5. Policy Challenges

5.1. Introduction

Foregoing chapters have established an overview of the main areas of transport policy that CVIS applications will affect. Opportunities and challenges for policy delivery have been explored and analyzed. This chapter builds on these findings in attempting to translate the opportunities and challenges in practical policy issues for deployment of CVIS.

The policy impact of CVIS is ideally considered at different levels, i.e. European, national and regional. What seem to be promising or optimal choices at the national and regional level might turn out to be sub-optimal or even destructive at the EU level. The challenge is to integrate, sometimes conflicting, relevant national transport policy areas CVIS plays a role in. The structure of this chapter is in accordance with this “level-perspective”, starting with policy issues at the European level and than down scaling these issues to the national level. Chapter 6 will subsequently deal more in depth with recognized policy issues at the regional level. The rationale behind this approach is that while the concept of cooperative systems has stimulated considerable debate on specific interpretations, it is clear that inherent in the notion is a concern for deployment of CVIS for Europe as a whole.

The structure of this chapter is as follows (see figure 5.1). The chapter starts with putting the long-term ambition of CVIS into the European framework of transport policy (section 5.2) Then, after having explained the methodological approach underlying this chapter (section 5.3), the results of the interviews and questionnaires held in various European countries are described.

In this description first, the state-of-the-art of cooperative transport systems throughout Europe is clarified (section 5.4). This section also provides an exploration of the priority in policy domains that are perceived as relevant in European countries, accompanied by the CVIS applications preferred. Contrasting these insights to the long-term ambition of CVIS makes clear the short-term challenges for further deployment of CVIS, along with the broader process of transformative change required in the longer term. In light of this, the focus shifts to policy challenges for deployment of CVIS at the European level (section 5.5). Attention is
given to the need for a common understanding and complex process management. Third, deployment issues at the national level are considered (section 5.6). Subjects that give rise to further debate in this chapter relate to agenda setting, conflicting policy domains, experimentation and interoperational standards.

Chapter 6 builds on these findings and translates these European and national deployment issues into recommendations for policy makers at the regional level. In this, there is a focus on the interaction patterns between public and private parties that are considered vital for actual deployment.

5.2. **The deployment ambition of CVIS: common European data communication infrastructure**

5.2.1. **European transport policy**

Mobility is a prerequisite for the way Europeans live today. Transport of people and goods is vital to satisfy this need for mobility and underpins our lifestyle by facilitating social interaction and the reliable distribution of goods across the continent (ITS Roadmap Outline, 2007). The economic importance of transport was highlighted in the Mid-term review of the European Commission's 2001 White Paper on Transport Policy:

> “Effective transportation systems are essential to Europe's prosperity, having significant impacts on economic growth, social development and the environment. The transport industry accounts for about 7% of European GDP and for around 5% of employment in the EU. It is an important industry in its own right and makes a major contribution to the functioning of the European economy as a whole. Mobility of goods and persons is an essential component of the competitiveness of European industry and services. Finally, mobility is also an essential citizen right.”

The overarching concern for Europe as a whole, however, is the growth in unsustainable forms of transport, mainly encouraged by disproportionate and excessive use of existing infrastructure. The three major challenges in the provision of sustainable transport include: [1] reduction of congestion and optimal use of the existing capacity, [2] increase of traffic safety and [3] address the negative impact on the environment while increasing energy efficiency and reducing the dependency on fossil fuels (ITS Roadmap Outline, 2007). The current unsustainable characteristics of transport represent a major concern for transport policy makers.

The 2006 review of the White Paper on Transport Policy “Keep Europe Moving” (European Commission, 2006) highlighted the contribution that system innovations can make, by making use of available and emerging information and communication technologies (ICT) applied to transport. CVIS can be acknowledged as a system innovation. The ambitions of CVIS fit well with the above outlook. During the interviews described later in the document many interviewees recognized the role cooperative systems can play to provide safe, efficient, sustainable and seamless transport of goods and people on the European road network and its interfaces with the other modes of traffic as well as to safeguard the competitiveness of European industry.

5.2.2. **Long-term ambition of CVIS**
From a government perspective, CVIS is specifically useful for monitoring traffic flows, supplying information to road-users and – if necessary and acceptable – steering traffic. In this way CVIS can contribute to reach various policy goals, e.g. regarding road safety, traffic management, sustainability etc. CVIS greatly enriches the available data and, accordingly, knowledge and understanding of the way the road network behaves under a variety of circumstances. It provides levers to manage the road network in accordance with policy goals.

From the user perspective, CVIS intends to provide advanced services, which make travelers mobility safer, more efficient and more comfortable. Besides the essence of CVIS, making information beyond the scope of existing vehicle sensors accessible and more broadly available, it provides seamless real-time travel and traffic information including multi-modal journey planning. It implies that each individual driver can obtain current online updates about his or her travelers’ optimal route to a specific destination, while e.g. bypassing possible accidents, traffic jams and other possible obstacles that may hinder a smooth traffic flow.

Ultimately, CVIS entails to function as a consistent European data communication infrastructure with common industrial standards to link various sources of data, e.g. from network operators, internet, roadside etc. Looking at figure 5.2 the intention of CVIS is that through data transformation, applications should be able to extract information from this telematics platform to inform/instruct the driver with local real-time information.

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**Figure 5.2 Ultimate aim of CVIS**

Before realization of this overarching data communication infrastructure a number of challenges need to be tackled. System innovations need to be developed to drive the maturity of CVIS forward. After having explained the methodological approach underlying the
information provided in this chapter, section 5.4 deals more in depth with this aspect.

5.3. **Methodological approach: interviews and questionnaires**

The data for this chapter was retrieved from two different sources of information:

– *face-to-face interviews* with (key) policy makers/advisors, familiar with cooperative systems and their policy implications for deployment and

– *questionnaires* distributed among government organizations responsible for policy-making or advising.

For the input of this chapter it was important to involve as many countries as possible, to get a representative image of the situation in Europe:

– to provide a full-fledged image of the state-of-the-art of cooperative transport systems in Europe;

– to explore the differences between European countries, in terms of their perspective on the functionality of CVIS and the deployment issues they encounter and

– to provide common recommendations for policy makers in European countries for policies to stimulate deployment.

**Interviews**

The strategy for retrieving this information was by arranging an interview with at least one policy maker from each of the most influential EU-countries in relation to transport policy. Deciding on these countries was done based on arbitrary grounds. Decisive were the amount of inhabitants (> 5 million) and the amount of motor vehicles per inhabitant (> 450 vehicles/1000 inhabitants – source: Eurostat, 2007). The assumption is that intelligent transport systems are more topical in countries with a high degree of motorization. The above selection resulted in the following list of countries: Austria, Belgium, Finland, France, Germany, Italy, The Netherlands, Spain, Sweden and the United Kingdom. For those countries, contacts for participating in the interview were selected via ERTICO, FEHRL, MIZAR, Telecom Italia and Rijkswaterstaat. Most people have been interviewed during the ITS Congress in Stockholm (2009), for the remaining ones, people were visited in their own country.

In the end, we have been able to interview fifteen policy makers from ten different countries (see figure 5.3. and appendix 1). From the selected countries only Italy is not represented. The interviews have been held with representatives of policy-dominated organizations throughout the various countries. Due to changes of roles and functions in Italy, it has not been possible - despite of repetitive insistence - to find someone willing to participate in the interview. Opposed to this we have been able to do an interview with a representative from Denmark, who was initially not selected.
Results from the workshop with POLIS (see chapter 4) provided the input for the interviews. In the interviews policy makers were asked to explain their current national policy on cooperative systems and the policy they advocate or recommend for the long-term future. Associated questions were related to the roles of and interaction patterns between public and private parties (see Appendix 2).

**Questionnaires**

The ambition with the questionnaires was to receive at least one response on a questionnaire from each of the remaining EU-countries, completed with Norway and Switzerland. Below, the approach and results of this strategy are discussed. The data retrieved was complemented with additional desk research and literature reviews.

Twenty-nine different European countries were approached, including the countries already approached for an interview. For the selection of the specific persons, the networks of ERTICO, FEHRL and Rijkswaterstaat were used as well as the list of contacts in the reports of the project “Advanced driver assistance systems in Europe” (2004). For the countries in central and eastern Europe, contacts within Rijkswaterstaat’s Partners for Roads Program were approached (Goppel, 2009). In a single case a request was sent directly to the minister.

To ensure an adequate level of response on the questionnaires, in some cases even up to twenty policy makers per country were invited via e-mail to fill in a digital questionnaire. If e-mail addresses turned out to be incorrect, attempts have been made to trace the right ones. One week after the first e-mail had been sent out, a reminder was sent to the people who had
not yet responded. One week after that, a phone call was made to the remainder of the people. If in a specific country no one responded on these attempts, other contact persons were approached. In the end, we have been able to get a response from 86% of the countries we approached. We received a response from thirty-six policy makers in twenty-five different European countries. For a geographical image of the diversity of countries that have participated in the questionnaire, see figure 5.4.

The questionnaire focused on three different aspects of CVIS. First of all, the questionnaire tried to explore what (transport) policy domains are perceived as relevant in different countries throughout Europe and how this prioritization differs between various countries. Specifically, the questionnaire marked out the CVIS applications preferred in different countries (see appendix 3 for the CVIS applications presented to the respondents). Secondly, the questionnaire provided insight in the opportunities and obstacles that different European countries expect and/or encounter in relation to the use of CVIS. Thirdly, the questionnaire tried to obtain information about the policies issues that various countries consider in relation to the deployment of cooperative systems.

The remainder of this chapter provides a structured and synthesized elucidation of the responses on the interviews and questionnaires. Additionally, desk research was done to support interesting statements of interview respondents by theoretical notions.
5.4. The transition perspective: state-of-the-art and future outlook

5.4.1. State-of-the-art: a diverse image of standalone applications

At present, a consistent European data communication infrastructure is far from materialization, or even from deployment. In following sections more attention will be given to how deployment can come within reach. Up till now, European countries primarily exploit standalone ITS applications, without using the wide-ranging opportunities of a consistent and overarching network of data transformation and integration. Also, the choice for the kind of (standalone) CVIS applications to deploy differs between countries, as parallels can be drawn with national policy domains that are considered imperative and associated transport problems that are encountered.

Figure 5.5 shows the main policy domains which CVIS applications are expected to affect according to various European countries. This data was retrieved from the questionnaire. In the questionnaire, people were asked to provide, on a scale from 1 [totally disagree] to 5 [totally agree], insight in the degree to which the utilization of CVIS could contribute to the six different policy domains visualized below. For each policy domain, the different answering categories were set out against each other in a percentage of the total amount of respondents.
Figure 5.5 shows that:
- Respondents believe the most in the contribution of CVIS to travel information, road safety and traffic control.
- Respondents are indifferent about the use of CVIS for economy and communication goals.
- Respondents are most negative about the contribution of CVIS to environmental goals.

Figure 5.6 adds to this by showing the shares of positive replies and by identifying the specific countries with respondents, who were the most positive about the contribution of CVIS to the various policy domains. For each policy domain, the amount of people that responded positively (with a 4 or 5) were added up, after which the numbers resulting for the different domains were set out against each other in a percentage of the total of positive responses. The figure shows that “road safety”, “traffic control” and “travel information” each represent about 20 to 25% of the positive replies. Respondents from five countries, who are very positive (= 5: “totally agree”) about the role of CVIS in all these three policy domains, are: Austria, France, The Netherlands, Poland and Slovakia.

Figure 5.7 displays the various CVIS applications which most of the respondents believe can be used to underpin these policy domains. A scale from 1 (“irrelevant”) to 5 (“highly relevant”) was used to indicate the relevance of these applications. Overall, the respondents have a positive attitude of the respondents towards the belief that CVIS applications can underpin the policy domains. The figure represents the countries with respondents, who believe the specific CVIS applications are “highly relevant”.

[Source: Interviews and questionnaires]
Based on a comparison of the figures 5.6 and 5.7, it seems logical to conclude, that the CVIS applications “Enhanced Driver Awareness”, “Cooperative Travelers’ Assistance” and “Monitoring and guidance of dangerous goods” are believed to be the most effective in contributing to the policy domains “road safety”, “travel information” and “traffic control”.

An analysis was done to deduce, whether these kinds of conclusions can indeed be drawn from the data. The general assumption upfront was that certain CVIS applications are developed with the intention to support certain policy domains:

- **Road safety** can be particularly enhanced by using the CVIS applications “Enhanced Driver Awareness” and/or “Monitoring and guidance of dangerous goods”.
- **Travel information** can be enhanced by using the CVIS application “Cooperative Travellers’ Assistance”.
- **Traffic Control** can be enhanced by using the CVIS applications “Cooperative Network Management”, “Cooperative Area Routing”, “Flexible Lane Allocation”, “Cooperative Travellers’ Assistance”, “Parking Zone Management” and “Access Control to sensitive areas”.

In the analysis, per country, the perceived contribution of CVIS to the various policy domains was set against the relevance for certain CVIS applications. The analysis shows that...
respondents from a few countries (Bulgaria, Denmark, France and The Netherlands,) are positive about the possible contribution of CVIS to the policy domains “road safety”, “travel information” and “traffic control” as well as about the corresponding CVIS applications. For other countries this causal relationship is far less obvious. In general – although many respondents are positive about the possible contribution of CVIS to policy – they would probably prefer an application that better fits their specific situation. Appendix 4 provides more insight in this analysis.

5.4.2. Opportunities of a fragmented uptake: prevent standardization in a too early stage

The CVIS project intends to strive for a structural change in the way the road network is used and managed. In view of that, it attempts to increase the integration between various policy domains. Based on these characteristics the CVIS project can be analyzed from a transition perspective. A transition is defined as a process whereby seemingly unrelated recurring patterns of societal change acting together lead to a major leap in the way a system is organized, practiced and experienced. (Rotmans, 2003).

Figure 5.8 shows the pathway of a transition, characterized by four phases of development, each having its own dynamics. A transition starts off and ends with a phase of perceived stability. This implies that changeable dynamics are ongoing, but do not lead to major visible changes. New niches and innovations are initiated in this phase, in great variety, trying to explore the desired interplay with societal influence and uncertain developments. These processes proceed in the undercurrent, implying that the technology that is developed has not yet fully matured and is therefore still awaiting to become the dominant means of practice. Central in this phase are the deepening and broadening of new technology.

![Figure 5.8 Phases of a transition [Source: Loorbach, 2007]](image)
The shift between the first and the third phase is then characterized by what is called “synchronization” or “modulation”. Several co-existing innovations and societal trends all move into the same direction and strengthen each other (Geels and Kemp, 2000; Rotmans et al., 2000). Because of that, the undercurrent slowly becomes mainstream. This means that a phase of scaling up has started in which the climate arises for niches and innovative technology to become more dominant and overtake the current practice. The third phase of a transition is characterized by instability. Here, the actual manifestation of the deployment process takes place, resulting in visible changes in practice.

CVIS manifests itself in the predevelopment phase in which various seemingly unrelated CVIS applications are explored and ultimately intend to trigger a process of structural change on the long-term towards an overarching cooperative platform for data transformation. From a societal transition perspective, it is crucial to keep options open in the beginning of such a process without striving to make the potential “winning innovation” the center of attention (Rotmans, 2005; Loorbach, 2007). It implies that standardization has to be put aside for a moment, preventing the urge to select for just one or a few technological solutions that seem promising now but can turn out to be destructive in the long run. First, more insight in the changeable long-term and societal dynamics has to be obtained; exploring the desirable position and function of CVIS applications in future deployment (read more about this issue in section 5.6.3.).

A too narrow focus on only a few promising CVIS applications could possibly lead to a lock-in situation and total breakdown of the intended system.

It hampers the learning capacity and cross pollination between various applications and countries. Transition theory suggests an iterative and stepwise process of [1] deepening, [2] broadening and [3] scaling up. Also during the interviews this line of reasoning was implied.

**Deepening**

According to the interviewees, initially many Field Operational Tests (FOT’s) should be carried out, whereby each individual FOT aspires to learn as much as possible from the deployment of one specific CVIS application in one particular context. This is the current situation: countries are experimenting with applications and setting up FOT’s in a predefined setting (problem definition, cultural background, regulations, institutions, etc.). E.g. Spain is experimenting with track and trace applications for controlling the import, export and routes of dangerous goods.

**Broadening**

The next step is to broaden these niche developments and associated learning experiences to various contexts. Through benchmarking and cross-pollination among countries, various learning experiences can strengthen each other in one and the same direction. This process links various CVIS applications and triggers synchronization, making the characteristics of an overarching cooperative platform insightful. Overall, this process gives an indication of possible pathways leading to a cooperative and overarching CVIS platform. The process enables the characterization and prioritization of feasible CVIS applications, accompanied by
Scaling up

The final step is to scale up the remaining CVIS applications to a level of performance suited to serve national and European goals. In this phase it is highly important to consider how work could be organized with the Member States and the different stakeholder communities in order to review and update these CVIS applications and to obtain input into pathways for deployment as well as commitment to pursue this pathway. Furthermore, what instruments are available to the EU to support development and deployment efforts (e.g. legislation and funding) and in which cases these instruments should be put to use. Not only in terms of technique, i.e. the importance of industrial standards (see section 5.6.3), but more importantly in terms of awareness and acceptance.

The current fragmented uptake of cooperative applications does not have to be a threat, but when approached in an integrative fashion, can indeed be an opportunity for synchronization. The situation provides many levers to initiate reciprocal learning experiences, contributing from different perspectives to a common, integrated and shared cooperative CVIS platform.

This intended process of transformative change plays out differently at different levels. The remaining part of this chapter discusses the policy issues that stand out at the European and the national level.

5.5. Challenges at the European level

This section is structured according to the scheme below. Two interrelated deployment challenges are described, relating to content and process. The former involves the contextual development of a common roadmap at the EU level, best facilitated by the use of a systems and network approach. The latter points out the relevance of jointly being involved in the process of developing this roadmap, in the course of which a sense of urgency, a mindset change and social learning are initiated.
5.5.1. The common understanding: the need for a roadmap

The introduction of ITS, and more specifically CVIS, is moving forward in different ways, as a function of the requirements of the various transport modes and of the degree of organization of the sector. However, the pace of deployment in road transport is rather slow. The interview respondents acknowledge the need to rely on the dynamics of the different industries, on the momentum of the markets and on a better co-ordination between all actors involved. Hence, they believe the EU needs to play an active role in supporting and, where appropriate, in providing a lead towards the deployment of CVIS. The following reasons can be mentioned, in accordance with the ITS Action Plan (2007):

- The assumption within the CVIS project is the necessity of a common data communication infrastructure to be able to face the challenges of today in terms of infrastructure capacity, road safety and environmental considerations.

- The complexity of the industries, the large number of parties involved and the need to ensure synchronization geographically as well as between the various partners, requires overall organization that can not be provided without public efforts at the European level.

The latter aspect points to the fact that technological developments follow rapidly on each other while changes in social policy take much longer. Additionally, the uncertainties stemming from long lead times and the time required to develop critical mass results in slow take-up and high initial costs.

The interview respondents believe these issues could be alleviated by following a so-called “target oriented approach”. Herein, consensus is developed around a roadmap at the EU level for the deployment of CVIS, based on policy priorities and political considerations, common components and a clear timeline.

The adequate use of a roadmap depends, according to the interview respondents on two aspects: [1] a systems approach and [2] a network approach. Both will be outlined below.

**Issue: Integrity of various policy domains**

*Solution: Systems approach*

**Issue: Incorporate various perspectives**

*Solution: Network approach*

**Systems approach: acknowledging the integrity of various policy domains**

Perceiving this ambition from a strategic level, it is crucial to use a roadmap as a vehicle to take action based on a systems approach. In order to understand the workable mechanisms of the complex pattern underlying the kind of change process that the CVIS project aspires to then linear and mechanistic thinking must give way to nonlinear and organic thinking, more commonly referred to as integrated systems thinking — a way of thinking where the primacy and complexity of the whole system is acknowledged.

A systems approach in the context of CVIS implies that within the roadmap, the integrity of various policy domains (e.g. road safety, traffic control and sustainability) should be
acknowledged to enable a consolidated and coordinated approach at the EU level. It can lead to a diversified and sometimes even conflicting image of deployment issues for Europe as a whole (see section 5.4.2.). However, only then emergent issues, which are sometimes fundamental in creating the climate for deployment, can be recognized, anticipated and directed. Transition processes unfold in a variety of policy domains simultaneously, and there is no single privileged point of view for their analysis (Rotmans, 2005). Furthermore, it ensures that various national oriented actions are taken up within the common framework of EU level issues and ambitions.

5.5.2. Complex process management: raising awareness, commitment and ownership.

Although the interview respondents pointed towards the necessity of a roadmap at the EU level, they acknowledged that the process of development is maybe even more important as it can raise awareness, commitment and ownership. Three potential functions of this development process stand out and should be acknowledged according to the interview respondents:

1. 
   
   Sense of urgency

   The design objective of a roadmap lies in trying to inform and inspire “CVIS-oriented” action by generating a sense of urgency for the policy issues at hand. A roadmap should not (merely) be a blueprint for action, but should have a function in encouraging processes of searching, learning and experimenting. A roadmap can then increase the pace of reflectivity for understanding better how the deployment of CVIS can be influenced and enhanced. It enables policy makers to respond in an anticipative way instead of being overwhelmed by unexpected circumstances. A roadmap is therefore only valuable when policy options are kept open and space and ambition is created for new directions in solutions.

2. 
   
   Mindset change
Another potential consequence of participatively developing a roadmap is to initiate a process of what we call “reframing”. It entails that policy makers shift the anchor or basis from which they view or actively anticipate future policy developments. If we interpret this in the context of CVIS, it means that policy makers start thinking and acting on the short-term in terms of what they have come to believe is necessary, according to the roadmap, for approaching a cooperative data communication infrastructure on the long-term. One example could be that the ambition of CVIS to provide comprehensive and dynamic information into the vehicle might change the necessary number and form of variable message signs or even fixed road signs and markings.

3. Social learning

When the roadmap is indeed developed in a participative context, a social learning process is initiated. Social learning is about developing interactions with others who have an alternative perspective on reality and jointly create another (or a new common) viewpoint on reality (Leeuwis, 2003; Social Learning Group, 2001). As policy makers are confronted with each others’ views and perceptions, they are influenced to gradually adjust their worldview based on what they come to acknowledge from others. This influence is reciprocal and differing perceptions become more similar over time, eventually resulting in a new, solid and common knowledge base to which everyone can relate, feels ownership for and wants to commit to.

Now that the challenges at the EU level have been discussed, the next section addresses how to tackle policy issues at the national level.

5.6. Analysis of the national level

This section deals more in depth with the obstacles for deployment at the national level. Based on the interviews it was revealed that in support of overcoming these obstacles priority should be given to certain actions. What is more, several of the interviewees pointed out that the order of execution is maybe even more important than the suggested actions itself (see the scheme below). This section sheds light on this ongoing discussion and tries to prioritize the actions suggested.

5.6.1. Getting CVIS on the political agenda

The discussion about the need for industrial standards prevailed in many of the interviews held, this while the political discussion on the choice for deployment of CVIS in relation to suggested policy at the national level is lagging behind. Especially the interviewees from Austria and Sweden acknowledged these circumstances and pleaded for action to get CVIS first on the political agenda and answer policy questions, before talking about interoperational standards.
The interviewees expect that it could be difficult to get CVIS on the political agenda. They believe insight in the cost effectiveness of deployment is a prerequisite in this respect. Throughout the interviews, three types of policy discussions were suggested to balance short-term costs and long-term gains. This was intended to facilitate a calculated and deliberate choice for how CVIS should be deployed and the reasons for its introduction:

1. **Realistic expectations**

   The first suggested policy discussion deals with realistic expectations. The roll-out of a cooperative data communication infrastructure is, in the beginning, probably dominated by a period wherein some applications work and others don’t, where only a small percentage of people are using CVIS applications (although a basic infrastructure should be established and working) and where different industrial standards prevail. More shortly, the costs associated with deploying cooperative systems are uncertain compared to tried and tested methods. It was suggested by the interviewees that this implementation period should receive separate and substantial attention on the political agenda. It would prevent disappointing results due to underestimation of costs.

2. **Economic value**

   The second suggested policy discussion relates to the economic value a cooperative system provides through the provision of societal services. I.e. not only value added services for drivers but also in terms of its contribution to sustainability and road safety for instance. Herewith, the interviewees implied that it is difficult to quantify value added services in economic gains. This situation can lead to a misrepresentation of the cost effectiveness of CVIS. It is suggested to feed the political discussion on cost effectiveness with quantified inputs on the value added services CVIS provides from implementation onwards.

3. **Contribution to long-term governmental objectives**

   The third suggested policy discussion relates to the contribution of CVIS to long-term governmental goals. Of course, CVIS will receive more attention on the political agenda if its contribution to long-term governmental goals like sustainability, road safety and traffic management is univocally clear. This raises the question what the function of CVIS should be related to governmental goals, and more importantly, what not. One of the
underlying questions is: in which cases does a cooperative data communication infrastructure add value on top of e.g. vehicle-to-vehicle communication?

The conclusion drawn based on the interviews is that CVIS should be deployed to contribute to those long-term policy goals, where individual driver behavior is expected to fall short. For instance, take the situation of a driver, who is in a hurry to get to his appointment. This driver will not respond to information about the speed limit enabling the reduction of his CO$_2$ emission. Discussions on policy recommendations for deployment should then focus on these specific situations. Potential questions are: what CVIS applications are relevant in these situations? What PPP construction is effective? Should drivers be informed or should legal enforcement be used? Etc.

When CVIS has reached the political agenda and relevant policy questions have been answered, a phase of experimentation can begin. Based on the learning experiences and insights stemming here from, thought can be given to common interoperational standards, national as well as at the level of the EU. This latter aspect is dealt with in section 5.6.3.

5.6.2. Conflicting domains

This section should be interpreted as an extension of the foregoing, elucidating the inherent complexity in deciding on the focus and explicit function of CVIS. Three examples are given of policy conflicts that should be discussed thoroughly according to the interviewees (see also the conflicts in section 4.6.2):

1. **Adverse information**

   The first conflict is put forward by the possibility of adverse information provided by a commercial service and a network operator. These two might give different advice because the individual travelers’ optimum and the network best options are not necessarily the same. At present it is the responsibility of the user to decide which advice to follow. This has already raised issues when navigation systems instruct drivers to make illegal manoeuvres. It is relevant to enhance the discussion about the kind of policy that needs to be developed to allow greater harmonization of advice between private services and network management.

2. **Liability**

   The second conflict relates to liability of the system (see also Topic 6 in the subproject DEPN: “Risks and liability”). To elucidate this further we revert to the example of the man who is late for an appointment, a situation in which – according to policy objectives – the system is intended to contribute to sustainability. However, the question is how to proceed in such a situation to enhance the possibility that the driver will indeed give priority to his speed limit instead of to his felt urgency to hurry up. When visualizing a continuum, one extreme is marked by the solution to use a “take-over system”, while the other extreme is marked by “providing information”. Here is where the paradox comes in: while a take-over system is probably the most effective solution, legally it is a very difficult solution to practice. When the system fails and an accident takes place, the question arises who is (financially) responsible for the system liability.
3. **Road safety**

The third conflict stems from safety. Although CVIS primarily is a data transformation infrastructure, the information is provided to the driver through in-car technology. From figure 5.5 it can be inferred that CVIS is, amongst other things, deployed to enhance safety. However, the question is if this objective is not undermined by its strong focus on the expected human-machine interface. The likely and prevailing consequence is that drivers are distracted to pay attention to the road when trying to control the in-car technology. Again, a noteworthy policy issue and example of conflicting domains that should receive considerable attention in the near future before standards are developed. Other potential hazards related to safety are mentioned in the figure below (see figure 5.9). The Y-axis represents the amount of respondents that thought the safety hazards mentioned were “important” or “highly important” (answered with a 4 or 5).

![Possible safety hazards](image)

**Figure 5.9 Possible safety hazards**

In addition, *privacy protection* was identified as a user value with a high potential for the emergence of conflicts. This will be discussed further in chapter 6, section 6.4.

5.6.3. **Standardization: the eventual focus of attention before actual deployment?**

In the foregoing it was mentioned that the initial costs of deployment are relatively high. This can only be endorsed when significant future impact of CVIS – in terms of safety, traffic management, etc. – can be expected and/or guaranteed. In the beginning of this chapter the significance of diversity in experimentation with CVIS applications between countries was stressed. This assumption holds for the initial phase of development (called “deepening” in section 5.3.2.) in which the reciprocity between learning experiences still contributes to novel experiences for deployment and insight into adapting to societal dynamics. However, for CVIS to fully achieve its potential, the interview respondents believe it is necessary to obtain a sufficient critical market mass.
To achieve the minimum penetration necessary for CVIS applications to make a significant impact, the interviewees believe it is essential to ensure - in due course - interoperability among countries. Therefore common specifications and standards for the use and operation of CVIS applications are needed for Europe as a whole.

“Standards” are defined here in the most extreme form: common technological agreements that enable drivers throughout Europe to direct the in-car technology of CVIS applications in the same way. This reasoning can be underpinned with theoretical insights from transition theory (see figure 5.10). The S-curve presented in the figure is similar to the one presented in figure 5.8. Such kind of development process presumes, from the pre-development phase onwards, anticipation on and consideration for all kinds of societal dynamics and potential resistance for implementation (social, economic, infrastructural etc.) surrounding the technical innovation itself. It is a means to explore the environment in which the innovation will be implemented and ensure a smooth and accepted market penetration. This should be done before actual deployment and associated market penetration is stimulated, to prevent resistance along the road. The line presenting a system breakdown in figure 5.8 is primarily focused on technological innovation and getting a high as possible market penetration and economic gain early on, e.g. focusing very strongly on technological improvements by means of for instance standardization.

![Figure 5.10 System breakdown [Source: Loorbach, 2007]](image)

Although, this may lead to an enormous (financial) impact in the short run, historical examples in which technological development prevailed has taught us that this can be destructive in the long run (e.g. modern windmills developed in The Netherlands proved not to meet societal standards, like providing a serene living environment, and their production and development have been taken over by Denmark and Germany).

For technological innovation to have a long-lasting influence it is vital to build in an experimental phase, before actual large-scale deployment is initiated, in which the societal,
economic and infrastructural dynamics are explored, anticipated and incorporated.

This does not imply, however, that standardization is not required in this initial phase. It is certainly essential to already start working on standards, but in a “loose” form. Considering the following roles of governments in the context of innovation (defined by the Innovation Platform Balkenende - Vught, 2005), could be useful in this:

1. role of governments to stimulate innovation at the level of civil services;
2. role of governments to stimulate innovation by investments in infrastructures;
3. role of governments to stimulate innovation by purchasing certain (innovative) products for their own organizations.

Standardization is relevant for all these roles. For now, standardization should start looking at the first role, in which governments could set boundary conditions. These standards should, on the one hand, be narrow enough to enable investors to start creating bottom-up market penetration but, on the other hand, be broad enough to allow space for renewal and adjustments according to practical experiences. These standards refer therefore not so much to technical solutions but to e.g. harmonization of requirements and user conditions. More shortly:

Standards should be motivating to keep experimenting and innovating, while at the same time be a legitimization for investors to spend money on the deployment of CVIS applications.

Indeed, the European Commission has already given mandate for the standardization of cooperative systems. With this mandate, the public authorities call on all interested stakeholders to agree on common solutions that would ensure geographical continuity of cooperative systems services. The aim of developing these solutions this early is to remove fear, uncertainty and doubt from the diverse infrastructure operators when deciding if cooperative systems should be deployed in their domain and which characteristics these systems should comply with. This will, according to the European Commission, help to produce a snowball effect necessary for reaching critical mass. Further reasoning is that these standards are already needed to fulfill the requirements behind the legally binding implementation measure. In order to ensure true Community wide interoperability, essential parts of the standards would need legal enforcement measures Innovation policy (European Commission, 2009).
6. Recommendations

This chapter intends to build on the foregoing chapter by translating the deployment issues mentioned there into guidelines for policy makers. This chapter should be read as the common result of interviews and questionnaires held throughout Europe with key policy makers, all aiming to convey their knowledge as broadly as possible, and anticipating that Europe as a whole is able to find common ground on which CVIS can be implemented. In that sense this chapter provides a few very important recommendations for policy makers to ease the deployment of CVIS throughout Europe.

6.1. Important policy issues

In accordance with the questionnaire, four different types of policy issues can be distinguished: finance, cooperation, the user perspective and governance (see figure 6.1). In the questionnaire each type of issue was represented by three to five examples. Each time, the question was, if respondents perceived this example as an important challenge for the deployment of CVIS. Responses could range from 1 (“not important”) to 5 (“highly important”).

The respondents who are represented in figure 6.1 believe that the majority of the examples associated with one type of policy issue (at least 2 out of 3, 3 out of 4 or 4 out of 5) are important (answered with “(highly) important”, 4 or 5). When comparing the types of issues in this way, it is obvious that respondents consider finance as the biggest issue (40% of the respondents), before the user perspective and cooperation (both about a quarter of the respondents). Respondents see issues related to governance as the least important (about 10%).

In this chapter these policy issues will be further discussed:
1. **Finance**: developing a business case at the EU level;
2. **Cooperation**: exploring a legitimate Public-Private-Partnership construction (PPP);
3. **User**: handling privacy protection with great care;
4. **Governance**: developing strategies to stimulate the introduction of CVIS.

6.2. Business case at the EU-level: added value of CVIS

It is univocally clear that the deployment of a new European wide data exchange platform like CVIS goes along with high initial costs. Figure 6.2 illustrates the number of respondents to the questionnaire that perceived the various examples underpinning the four types of policy issues as relevant challenges for the deployment of CVIS (answered with a 4 or 5). The figure is based on answers from totally 30 respondents. Figure 6.2 shows that respondents see the costs of deployment and roll-out of CVIS as the most important financial challenge. Hopefully, there will be also high rising benefits in time. To be able to weigh these financial flows, it is recommended to develop a business case at the EU level. It not only makes the added value of CVIS insightful, but also identifies the minimum required investments in the short term. Moreover, a viable business case leads local authorities to perceive CVIS as a more efficient way to deliver policy in which various parties can fulfill their interests.
Guidelines for Policy Makers

on these insights, investments will be stimulated and a feasible PPP construction that fits the business case can be explored further.

![Types of policy issues for the deployment of CVIS](chart.png)

- **Countries with respondents indicating the user perspective as a big challenge for deployment** Austria, Belgium, Bulgaria, Czech R., Finland, Germany, Greece, Hungary, Ireland, Lithuania, Malta, Romania and Sweden
- **Countries with respondents indicating governance as a big challenge for deployment** Bulgaria, Czech R., Finland, Latvia, Lithuania, Malta and Sweden
- **Countries with respondents indicating cooperation as a big challenge for deployment** Austria, Czech R., Denmark, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, NL, Poland and Romania
- **Countries with respondents indicating finance as a big challenge for deployment** Belgium, Bulgaria, Czech R., Denmark, Finland, Germany, Greece, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Poland, Romania, Sweden and the UK

Figure 6.1 The degree to which various types of policy issues are perceived relevant
[Source: Questionnaire]

6.3. **PPP construction: reorientation of roles**

Most interviewees and respondents on the questionnaire acknowledged the responsibility of PPP in the deployment of CVIS. However, they also mentioned that these (mutual) roles are far from crystallized or efficient practice. Moreover, contacts from most countries recommended reorienting the current role of governments in relation to that of private parties. A number of contacts indicated that it is important to prevent too much detailed control and coordination from governments in deploying CVIS. This can possibly lead to resistance with private investors, who feel their interests and private sector business models will be undermined (see also figure 6.2, the items related to “cooperation”).
The interviewees from the UK believe that if there is a good business case for customers, logistics operators and the local authority, then government role has limited added value. According to the interviewee from Belgium, the government role should be restricted to set common standards for data protection and provide clarity and constraints on the use of CVIS applications. They should act as an enabler to support bottom-up innovation and to help disseminate experience and good practice with CVIS more widely. The interviewee from Finland adds to this that deployment should be market led and evolve in response to user response and needs. They believe CVIS applications should come in a package, wherein the

**Investing in roadside units**

Both the German car industry as the road authority in Hessen do efforts for the further development of cooperative systems. To carry out a next step a car manufacturer requested Hessen to install a number of roadside units. Doing this at a relevant scale will require substantial investments.

Now for the road authority an important issue is, how to help the developments in the most effective way: [a] comply with the request and install roadside units in cooperation with this car manufacturer, using present technical requirements, with the risk that in a further stage of development these roadside units will appear of limited use or [b] wait with doing investments until more is known about the necessary roadside units, so that investments can be done more effectively, but... with the risk that none of the parties moves.
role of private parties is to produce value added services that fit user needs. Most importantly, the reorientation of roles together with a feasible business case should overcome the current situation in which various stakeholders are waiting on each other to make the first move (see also the example illustrating why stakeholders hesitate to take the first move).

6.4. User perspective: attention for privacy protection

With regard to the “user perspective” respondents from various European countries believe that privacy protection of the individual driver, while handling personal and commercial data represents a vital challenge to overcome (see also figure 6.2, the items related to the user perspective). Nevertheless the interviewees from Belgium and Germany indicate, that sufficient techniques are already available to guarantee privacy of the individual driver, e.g. separating personal and collective data. The interviewee from Belgium adds, that the lacuna possibly lies in the fact that car traffic is unique in dealing with privacy. When comparing it to flight traffic or public transport, personal data is always stored without any offence. Moreover, several interviewees mention the mobile phone, which is generally accepted and with which it is also technically possible to track the users. It leads to the proposition that the attitude of road users in relation to privacy protection should be softened. If the issue of privacy protection is handled with care and communication about the subject is open and transparent, the interviewees expect no insurmountable obstacles in this field.

6.5. Governance: strategies to stimulate

Political agenda

Political discussions on the choice for deployment of CVIS at the national level seem to lag behind (see also section 5.6.1). It is of major importance first to get CVIS on the political agenda. Insight in the cost-effectiveness of deployment is a prerequisite in this respect. Political discussions on cost-effectiveness should be fed by quantified inputs on the value added services CVIS provides, including the economic value of societal services. Moreover, it is important to raise realistic expectations for the short-term and to make the CVIS contribution to long-term governmental goals univocally clear.

Figure 6.2 confirms the importance of the CVIS contribution to long-term goals. In the domain “governance” the respondents to the questionnaire give the most attention to the items “6. Contributes to existing policy targets or extend them” and “7. Smoothly link up to existing transport policies”.

Overcoming policy issues

Figure 6.3 displays the amount of policy issues that respondents to the questionnaire think are important for the deployment of CVIS, related to the perceived status of deployment. Since the questionnaire presented four different types of policy issues, each underpinned by three to five examples, each respondent could overall perceive 16 policy issues as a challenge to be tackled in the light of the deployment of CVIS. The figure represents on the vertical axis the amount of policy issues that were rated positively (“important” or “very important”, 4 or 5).
This amount is set against the perceived degree of actual deployment in practice on the horizontal axis. The latter was based on answers on the question: “In your country, to what degree do cooperative systems receive attention for policy delivery?” The answers range from “only in Government documents” to “industrial partners preparing the future technical realisation”.

![Figure 6.3 Challenges for deployment in relation to status of deployment](Source: Questionnaire)

Although the figure does not show a very clear relationship, it seems that respondents identify the most policy issues as a challenge to overcome, when they consider the deployment in the very first phase. The number of policy issues seems to decrease, when the deployment is advancing (see the transparent light area across the quadrant).

If this relationship is indeed representative for the situation in Europe, one may conclude that European countries are still in an early and uncertain stage of development of CVIS. Moreover, this figure validates the requirement to first start experimenting more broadly in order to feel secure in dealing with the deployment issues, before focussing too much on developing industrial standards. 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 CVIS 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 CVIS introduction.
Government strategies

In order to explore whether the data from the questionnaire could give guidance for government strategies for deployment, the indicated number of opportunities and obstacles per policy area were analyzed. In the questionnaire for a number of policy areas (traffic management, road safety, etc.) several examples of opportunities and obstacles per policy area were provided. The question for each of these examples was, if respondents recognized this as an important opportunity or obstacle for their country. The possible answers ranged from 1 (unimportant) to 5 (highly important).

Few opportunities

- Spain
- Latvia
- Austria
- Czech Republic
- Slovakia
- Hungary

Many opportunities

- The opportunity of CVIS for traffic control which received the least votes
  Use of narrow lanes and smaller headways
- The obstacle of CVIS for traffic control which received the most votes
  Liability system and investments
- The obstacle of CVIS for traffic control which received the least votes
  Latent demand extra traffic and enforcement

Figure 6.4 Opportunities and obstacles for traffic control
[Source: Questionnaire]
Considering the number of opportunities and obstacles seen as “important” or “highly important” (4 or 5) figure 6.4 and figure 6.5 were drawn. These figures show on the horizontal axis the number of important obstacles and on the vertical axis the number of important opportunities. The four quadrants in the figure could give an indication for government strategies (see explanation). Figure 6.4 shows results for the policy domain traffic management; figure 6.5 shows results for the domain road safety.

**Figure 6.5 Opportunities and obstacles for road safety**

[Source: Questionnaire]
Government strategies

1. Facilitating: when European countries see many opportunities and only a few obstacles for CVIS, the expectation is that they do not need much influence from governments to initiate deployment. The role of Governments is merely to function as an enabler and facilitator.

2. Stimulating: when European countries see many opportunities for CVIS but also many obstacles, governments can be sure these countries strive for deployment but need additional stimulation to overcome the obstacles.

3. Monitoring: when European countries see few opportunities for CVIS and also few obstacles, they probably do not have the direct ambition to implement CVIS on the short-term. Initially, governments purely need to monitor the developments, with the optimism that in the near future their value pattern will change and governments can have a more active role.

4. Anticipating: when European countries see few opportunities for CVIS on the one hand, but many obstacles on the other hand, the chance exists that these countries show resistance to any influence from governments. This is because their expectancy towards CVIS is dominated by negative feelings. Governments need to anticipate this behaviour and try to prevent negative influences.

Note that figure 6.4 and figure 6.5 are based on a very limited amount of data per country. In many countries only one person responded to the questionnaire. Although only contacts from policy-making organisations or policy-advisors were approached, opinions of the respondents are not necessarily representative for their countries. In general the answers are the respondents’ personal views.

This means that the results in the figures should be considered as a very first indication. Based on the figures it is not possible to draw valid conclusions per country. Nevertheless the figures can be useful as a start for further research and further discussions about optimal government strategies per country.

The figure on traffic control (figure 6.4) shows that the positions of the countries are more or less scattered over the whole diagram. Only the quadrant “monitoring” contains very few countries. In the figure on road safety (figure 6.5) by far the majority of the countries are in the quadrants “facilitating” and “stimulating”, with the emphasis on the quadrant “stimulating”. If these results are representative, there are more opportunities to introduce CVIS in the area of road safety than in the area of traffic control, i.e. a facilitating or stimulating government strategy could be adopted for road safety in more countries than for traffic control.
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Appendix 1  Names and countries of interview respondents

BELGIUM
Pierre Vijverman
Verkeerscentrum
Departement Mobiliteit en Openbare Werken
Vlaamse Overheid

AUSTRIA
Manfred Harrer
Telematische Dienste
ASFINAG

DENMARK
Åke Egemalm
Office for Traffic Management and ITS
Area Centre for Greater Copenhagen

FINLAND
Prof. Risto Kulmala
VTT Building and Transport

FRANCE
Jean-Francois Janin
Ministry de l'equipement, des transports,
de l'aménagement du territoire, du tourisme et de la mer

GERMANY
Hendrik Zurlinden
Hessisches Landesamt für Strassen und Verkehrswesen
THE NETHERLANDS
Geert Draijer
Ministry of Transport, Public Works and Water Management

Martin van Gelderen
Ministry of Transport, Public Works and Water Management

Gerben Bootsma
Rijkswaterstaat

SPAIN
Fernando Zubillaga Elorza
Cluster TIL-ITS Euskadi
Basque Government

SWEDEN
Mari-Louise Lundgren
Swedish Road Administration

Peter Wessel
Swedish Road Administration

UNITED KINGDOM
Stefan Trinder
Strategy and Policy
Transport for London

Jill Adam
Transport Technology and Standards
Department for Transport

Spencer Palmer
Traffic Management Division
Department for Transport
Appendix 2 Interview questions

1. What is the present national policy on cooperative systems in your country?

2. To what policy domains can CVIS contribute in your country?
   i. What is the added value of CVIS herein? What opportunities does CVIS provide?
   ii. What (policy) obstacles do you recognize that could hamper the deployment of CVIS?
   iii. From what perspective is CVIS interesting to deploy? (e.g. driver, road authorities, control centers)

3. Do you anticipate conflicts between various policy domains when implementing CVIS?

4. What CVIS applications are already being rolled out in your country?
   i. What actors should play a role in the deployment of CVIS in your country?
   ii. What chances for new cooperations / networks / parties / knowledge development do you see?
   iii. What policy choices must the government make with regard to deployment of CVIS?
   iv. What is the desirable role of other market parties?
   v. How do you see the interaction between the government and other market parties?

6. What are short-term and long-term steps for the deployment of CVIS?
   i. What shifts in transport policy are taking place in your country? Does CVIS fit within these developments?
   ii. To what extent does CVIS fit long-term goals of Ministries on transport policy in your country?
   iii. Does CVIS connect to / strengthen existing innovations for transport policy? What other innovations are known in this field? What roadside systems should be maintained or created for utilization of CVIS to be well implemented?
Appendix 3 CVIS applications presented in the questionnaire

1. Cooperative network Management

   Goal: optimal traffic management in an urban area by using vehicle/driver destination and other characteristics, and individualized route guidance (control horizon 5-60 minutes).

2. Cooperative Area Routing

   Goal: to offer alternative routes in a part of the town in the event of an accident or incident (control horizon 1-5 minutes).
3. Cooperative Flexible Lane Allocation

Goal: to increase the capacity of certain road sections in and around towns by allowing the use of bus lanes, without causing any disturbance to the public transport.

4. Enhanced Driver Awareness (EDA)

Goal: to alert drivers (and infrastructure) about road conditions / incidents further down the road.
5. Cooperative Travellers' Assistance (CTA)

Goal: to give support to drivers by planning a personalized route to follow, and to help the traffic manager to predict traffic congestion and delay.

6. Monitoring and guidance of dangerous goods

Goal: to ensure that dangerous goods do not cause any risks on public roads and are guided along safe roads.
7. Parking zone management

Goal: to allow advanced booking of urban parking space (to professional and other drivers).

8. Access control to sensitive areas

Goal: to monitor vehicles approaching sensitive areas (such as historic city centres) in order to allow / deny access.
Appendix 4  The relation policy domains - CVIS applications

Based on the results from the questionnaire, an analysis was done to deduce, whether the respondents think the presented CVIS applications contribute to the policy domains “road safety”, “travel information” and “traffic control”.

The general assumption upfront was that certain CVIS applications are developed with the intention to support certain policy domains:

– **Road safety** can be particularly enhanced by using the CVIS applications “Enhanced Driver Awareness” and/or “Monitoring and guidance of dangerous goods”.
– **Travel information** can be enhanced by using the CVIS application “Cooperative Travellers’ Assistance”.
– **Traffic Control** can be enhanced by using the CVIS applications “Cooperative Network Management”, “Cooperative Area Routing”, “Flexible Lane Allocation”, “Cooperative Travellers’ Assistance”, “Parking Zone Management” and “Access Control to sensitive areas”.

The figures A4.1, A4.2 and A4.3 show that this assumption is not consistent looking at the answers from the respondents from various European countries. The horizontal axis represents whether respondents believe CVIS can contribute to the transport policies in their countries. This is shown for the three transport policy domains mentioned above. The vertical axis represents, whether the respondents indeed prefer the intended CVIS applications to underpin these specific policy domains. Respondents, who indicate that [1] CVIS contributes to the policy domain and [2] the corresponding CVIS applications are useful tools, are represented in the upper right quadrant.

The figures show that respondents from a few countries (Bulgaria, Denmark, France and The Netherlands) are positive about the possible contribution of CVIS to the three policy domains, as well as about the corresponding CVIS applications. However, for respondents from many countries this relationship is far less obvious. Although many respondents are positive about the expected contribution of CVIS to policy in general, they would probably prefer applications that better fit their specific situations and needs.
Figure A4.1 ROAD SAFETY: Consistency between the stated relevancy of CVIS for the policy domain and the CVIS applications preferred [Source: questionnaire]

Figure A4.2 TRAVEL INFORMATION: Consistency between the stated relevancy of CVIS for the policy domain and the CVIS applications preferred [Source: questionnaire]
Figure A4.3 TRAFFIC CONTROL: Consistency between the stated relevancy of CVIS for the policy domain and the CVIS applications preferred [Source: questionnaire]