Implementation Road Maps Monitoring Report 2009

Final Draft

The Implementation Road Maps Working Group

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Contents

LEGAL NOTICE

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EXECUTIVE SUMMARY

The Implementation Road Maps Working Group of the eSafety Forum commenced its activities in July 2003. The objectives were

1) to identify the technical and economical potentials of the industry as well as the topics and time table for infrastructure improvements by the public sector with regard to eSafety systems capable of affecting road fatalities in Europe by 2010, and

2) to develop regularly reviewed road map which focuses technological steps and economic implication models for introduction of intelligent integrated road safety systems as well as the required improvements in road and information infrastructure.

The working group assessed all feasible eSafety systems according to a comprehensive evaluation criteria reflecting its objectives, and provided a final report in 2005 including eleven priority systems, which the working group saw best fit for large-scale deployment and gave recommendations towards their deployment before 2010.

The working group concentrated on monitoring and promoting the deployment of the priority systems, and has in 2008 and 2009 carried out a renewed assessment of systems with the purpose of improving the safety and energy-efficiency of the transport system by 2020 with the help of eSafety systems.

The priority vehicle based systems are now:

- Blind spot monitoring
- Adaptive headlights
- Obstacle & collision warning
- Lane departure warning
- Emergency Braking (added in 2008)

The priority infrastructure-related systems are:

- eCall
- Extended environmental information (Extended FCD)
- RTTI (Real-time Travel and Traffic Information)
- Dynamic traffic management
- Local danger warning
- Speed Alert
- Dynamic navigation (added in 2008)

One key question is how to promote the deployment rate of these systems in future. There are also differences in feasibility between vehicle-based systems and more infrastructure / or mixed systems because their business cases vary. Different incentives are likely to enhance the customer awareness for eSafety features. For each priority system, two market penetration forecasts were estimated, one based on "business as usual" conditions and the other based on incentives and other measures to promote the deployment of the system.

The potential safety effects of the systems were estimated based on the most recent results of research evaluating the impacts of such systems.

The recommendations for the priority systems as identified in the Implementation Road Map working group are given below:

<u>Recommendations for in-vehicle systems:</u>

a. The automobile industry, European Commission, the Member States and other stakeholders should enhance the customer awareness of the safety benefits of such systems in vehicles through a joint well structured and harmonized European campaigns, driver training & education programs, media (consumer magazines).
   The awareness (and involvement) regarding eSafety systems among the personnel involved in the sales of new passenger cars should also be significantly increased. This could be achieved by a European wide educational effort organised by the OEMs and their respective suppliers.

b. The Member States and insurance companies should give financial/fiscal incentives to customers to buy vehicles equipped with effective systems fulfilling the detailed specifications and standards drawn up for such specific systems. For this purpose, the discussion should start without further delay to clarify the possibility for incentives given by governmental authorities and/or insurance companies and other stakeholder, who benefits from the introduction of such systems to follow the example of tax incentives for lower emission vehicles.

c. The EC and the Member States should support frequency allocations for radio-based systems. Earlier automotive applications used ISM bands (ISM – Scientific Industrial Medical). Meanwhile these bands are overcrowded, their usability for applications of automotive safety is limited. In addition higher bandwidth is required e.g. for automotive radar to achieve higher local resolution. Some sensor applications use also Ultra-Wide Band technology. Frequency allocation means frequency sharing with primary or secondary services and is very complex, time consuming and leading to restrictions if not early enough done. Support is needed to achieve viable frequency allocations especially for applications with high benefit for road safety. This includes also the possible support in the worldwide harmonization of the frequency allocations.
e. d. The European Commission should initiate actions to make information on the availability and actual integration of eSafety systems in vehicles available for the public. The data collected should be used for accident research and vehicle inspection purposes across Europe.. While OEMs know exactly which safety option the customer has selected, this information is not generally available. It needs to be discussed between the different stakeholders how such information can be made available to improve the eSafety system impact database and how such system affect road safety. The European Commission, together with the Member States, industry and all other stakeholders,

should continue promoting R&D to improve existing safety and develop new improved safety systems. Research should also continue on co-operative (vehicle and infrastructure) systems, especially on applications dedicated to safety and energy efficiency. Improvements on existing systems through the addition of V2V and V2I communication functionality should also be considered.

d. All stakeholders should jointly develop feasible sustainable business models for each application on the principle that those who benefit from the introduction in the form of reduced accident-related costs should share these benefits with those who have to carry the investments and costs. This should also cover nomadic and aftermarket device based solutions

e. Steps towards deployment should be supported by the European Commission through Field Operational Tests (FOT's) and CIP pilots considering appropriate and feasible sustainable business models for each application. In specific cases, it may be necessary to establish PPP's (Public-Private Partnership) arrangements between public authorities and private companies.

f. The role nomadic devices in speeding up the deployment of safety applications and related services needs to be further elaborated. The eSafety Nomadic Device Form has an important role to play to bring together the different stakeholders.

<u>Recommendations for autonomous vehicle systems:</u>

In order to increase and accelerate the market penetration of *e*Safety systems with highest safety benefits, such as and going beyond ESC,

g. EuroNCAP should incorporate such systems into their rating as soon as proven technology and safety benefit data becomes available, the functionality of the systems can be adequately tested and performance of different systems can be correctly measured. It is important to provide a quality assessment instead of just simple Yes/No criteria.

The European Commission and the Member States should consider regulatory actions (such as making a system mandatory equipment in new vehicles as already decided for ESC and Tyre Pressure Monitoring) only as a last option, when such action is judged as essential and beneficial for both industrial and public stakeholders and when the related technologies have proven their maturity. Socio-economic reasons and respecting the principle of subsidiarity are other important decision criteria. Voluntary solutions should be favoured. Whenever regulation is considered, it has to be ensured that the availability within the timeframe is given by the industry.

h. The Member States and the industry should comply with the new European Statement of Principles (ESoP) for HMI (Human Machine Interaction) for safe integration of devices into the vehicles and the recommendations of the HMI Working Group to ensure future user acceptance and a safe application and function of the systems during their whole life cycle

i. The automobile industry, European Commission, the Member States and other stakeholders should continue to support R&D efforts to develop new technologies and solutions for in-vehicle safety systems as well as evaluating the effects of *e*Safety system on safety, mobility, environment, economy and employment.

Recommendations for infrastructure-related systems:

In order to increase and accelerate the deployment of safety beneficial infrastructure-related *e*Safety systems,

j. The Member States should ensure the deployment of socio-economically feasible systems and services according to their responsibility and in line with the requirements accepted at the European level.

k. Improvements in the infrastructure are required to implement a number of infrastructure-based and co-operative solutions. Although those improvements depend essentially on the Member States, the European Commission should develop all the necessary steps to support them, through the instruments at their disposal (e.g. ITS Action Plan, EASYWAY project, TEN-T programme, Urban Mobility Action Plan, Road Safety Action Plan & Charter) and using new methodologies like Lead Markets (increase the willingness of countries and regions to take on the role as “early adopters” for eSafety systems) and Pre-Commercial Public Procurement.

l. The industry, European Commission and the Member States should together take actions to ensure that digital maps with the information required by the *e*Safety systems are developed for all roads in the Member States covering commercial and private traffic needs.

m. The actual systems will in the future be object of further integration and improvements towards an increasingly automated driving. Safety will be increased, fuel consumption will be reduced, energy-efficiency as well as the overall capacity of the transport system will be increased. However, the European Commission should assess a number of issues that need to be addressed:
• Standardization of communication channels, protocols and public services across Europe; • Standardized equipment of intelligent road infrastructure across Europe to enable interoperability
• Same (minimum) level of quality of services all over Europe;
• As safety responsibility/liability is based on a possibly outdated Vienna Convention it is advisable to review the current text in order to capture technological progress and to meet today’s and future developments; and
• Business models needs to be developed and made attractive for all involved parties. Individual commercial stakeholders will only be

interested in participating when their return on investment is positive (positive business case)

n. The European Commission and the Member States should continue to support R&D efforts to develop new technologies and solutions for infrastructure-related safety systems as well as to evaluate the effects of such systems on safety, mobility, environment and other socio-economic factors

Concerning eCall,

o. The European Commission, the Member States, the industry and other stakeholders should support the European and national implementation platforms to ensure the deployment of eCall across Europe
p. The European Commission should actively follow the standardisation activities in CEN and ETSI to ensure the timely delivery of standards and operating requirements
q. The Commission and Member States need to ensure that open legal and privacy issues are solved prior to introduction to avoid liability cases going beyond technical product liability
r. System functionality needs to be sufficiently tested
s. Industry lead time requirements need to be honoured

Concerning RTTI,

t. The European Commission, the Member States and the industry should follow the recommendations of the RTTI Working Group

Concerning dynamic traffic management and local danger warnings,

u. The road authorities and operators should develop together a European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with vehicle and telecommunications industry.

Concerning speed alert,

v. Concerning speed alert, the European Commission and the other stakeholders should solve the currently open issues and utilise the implementation roadmap produced by the SpeedAlert project. The main issues are related to quality of data, accuracy, actualisation of information and cooperation between public authorities and industry. Public authorities need to make information available on temporary construction areas, their duration as well as position of important traffic signs and not leave it to industry to collect such information themselves at high costs.

1 INTRODUCTION

The original task given to the Implementation Road Maps Working Group (IRM WG) in 2003 was on the one hand to investigate how to promote the roll–out and deployment of vehicle and infrastructure based systems inclusive cooperative systems but also on the other hand to install a regular monitoring process for taking track of the achievements from different measures promoting the deployment of already existing applications and the necessary support for new applications which might be in line with the over all goal to reduce the road accidents and fatalities.

The first timeline of 2010 has now been extended to 2020 in view of the speed of deployment of new eSafety systems and the yearly renewal rate of the whole fleet in Europe as well as the influence of new EU member states. So far, the key questions are still the same, but between 2003 and today there have been significant achievements in the deployment and also in the availability of new systems and functions.

It is a clear target to reduce the number of fatalities in a significant way, but it is still complicated to describe the whole bundle of challenges to reach this very essential target. We still have some major problems like low public awareness and customer willingness to pay more for safety features. The workshops organised together with eSafetySupport and the IRM WG had clearly indicated that we need large scale deployment for the key systems, otherwise we have too much delay between market availability and whole fleet penetration. Also, if only a small number of systems is sold, the business case will be problematic for the involved partners. Strict regulations for fitment of safety related systems should only be used as the last possible option. The primary choice is to have standardized market driven solutions.

In 2009, the eSafety Forum has been extending its scope to have a triangle of safe, clean, and smart applications to convince the customer to invest into systems and fitments which are going to have beside some very smart solutions like dynamic traffic information and navigation also the reduction of fuel costs, CO_2 emissions, and accident risks. Large scale deployment will be more likely if this combination of benefits is available. Increasing fuel prices and congestion throughout Europe have supported the market demand for such systems.

This report summarises the actual situation concerning the eSafety deployment and impacts in general terms as well as showing what deployment and results can be achieved by measures taken and identifying future task and recommendations to involved stakeholders in line with the overall goal of reducing road fatalities.
A proposed processing model will describe how we can monitor what measures are having sufficient effect for deployment and the overall result of this for a yearly update.

2 REVIEW OF THE PRIORITY SYSTEMS

The agreed general approach was defined as follows:

A Survey of existing and feasible upcoming *e*Safety systems and available data sources
B Qualified ranking for identification of priority systems:
  - Relevant factors are:
    - availability and capability
    - estimated impact on road safety
    - general user intentions
    - cost / efficiency business models /cases

C Evaluation of findings and best / worst case figures under certain circumstances
D Implementation issues
E Recommendations for actions to promote roll-out and deployment of priority systems
F Method for regular updating of the implementation road map

The Working Group dealt with a number of systems, which were first classified according to the timing of their operation with regard to the accident or crash:

1) normal driving,
2) danger phase,
3) crash unavoidable,
4) in-crash, and
5) post-crash.

The primary systems (1 and 2) reduce accident risk whereas the secondary ones reduce the consequences of accidents.

The functions can be autonomous, co-operative or infrastructure based and hence the following classification was adopted:

1) Vehicle autonomous systems,
2) Vehicle autonomous systems with network potential,
3) Aggregate information in the vehicle with vehicle to vehicle or vehicle to infrastructure/infrastructure to vehicle (v2v or v2i/i2v) communication, and
4) Functions with support/communication from/to infrastructure.

After clarification of tasks and available options, it was possible to identify the relevant systems. It should be pointed out that the WG only included systems where the market introduction would be possible in the very near future i.e. by 2010. A number of systems are still under research and hence, out of the time frame of this report. The list of systems needs to be adapted when emerging technologies appear on the market. The systems were first classed according to the following categories:

A vehicle based autonomous systems
B infrastructure & vehicle based systems
C infrastructure based systems

Systems that are already in all new cars were left out of this list like ABS.

Later, these were reclassified into two categories of vehicle based (A) and infrastructure related systems (B and C). The systems are described in Table 1 and 2.

*Table 1. Description of vehicle based e*Safety *systems.*

Adaptive Brake Lights	Triggered by the strengths of brake activation the rear brake lights are illuminated in different kinds to indicate emergency braking manoeuvres to the following vehicles
Adaptive Head Lights	The system consists of electromechanical controlled headlights to ensure optimum illumination of the lane in bends. The headlight is directed into the bend as soon as the vehicle begins cornering. A reduction of the glare to the upcoming vehicles is possible. Vehicle speed, yaw-rate and steering wheel angle can be used as input data for the controller of the system.
Alcolock (Alcohol ignition interlock)	An alcolock prevents a car from starting if alcohol is found in the air exhaled by the driver. The alcolock is a technical device that is connected to the vehicle ignition system. Before starting the car, the driver must blow into a mouthpiece to check the air exhaled. If this contains alcohol with BAC (Blood alcohol content), equal to or more than the legal limit, it will not be possible to start the engine. Alcolocks are used today for quality assurance purposes and are part of DWI (Driving-While-Intoxicated) offences. In some countries, anyone convicted of DWI may apply to participate in an alcolock programme instead of losing their driving licence. One of the requirements placed on those taking part is that they must blow into the device at random intervals during the course of a journey. Any trace of alcohol found in the exhaled air is registered in the alcolock memory function. A number of companies use alcolocks in their endeavours to quality-assure their transport and to guarantee that deliveries are carried out by sober drivers.
Automatic Headlight Activation	When activated, the system switches on the headlights automatically when major environmental conditions for the use of head lights are present. The system detects the darkness and the light conditions in the environment.
Blind spot monitoring	Using solely a mirror for rearward view is normally inadequate due to so-called "blindspots" on both sides of a vehicle. . Different systems can either provide better vision into the blind spot area or supplemental information regarding an obstacle being there, e.g. by warning signals. Wide angle side mirrors reduce the blind spot area. If the mirrors are heated, the vision in bad weather conditions is optimised further. Camera techniques with image processing or radar sensors can give additional information about the situation in the blind spot area. An adequate HMI solution is generally a prerequisite for an effective system.
Driver Condition Monitoring	The system monitors the condition of the driver basically through eye-movement sensors . Discussed parameters today are drowsiness, distraction, and inattention. Systems today are focussing on commercial (long-distance) drivers but general applications also for passenger cars might become technically available and affordable
Dynamic control systems (ESC etc)	Active Front Steering: The AFS allows - electronically controlled - a variable steering transmission and steering force support. Two different inputs overlap, the steering angle from the steering wheel and a correction angle given by a controller through a special gearbox. Electronic Stability Control ESC: Stabilises the vehicle under all driving conditions and driving situations within the physical limits. Helps to stabilise the vehicle and prevent skidding when cornering or driving off through active brake intervention on one or more wheels and intelligent engine torque management. Active Body Control ABC: Active damping and suspension system minimising car body roll and pitch motion, adjusting ground clearance according to speed, allowing for a two stage ride height including load-independent all-round self-levelling.
Event data recorder	On-board EDR units collect certain vehicle parameters to monitor quality of driving and technical functionality. Those data, before, during and after an event, can be used for scientific, technical and legal purposes. Driver awareness of such a system might reduce the number and severity of drivers' crashes. Privacy issues might need to be considered.
Inter vehicle hazard warning	To transmit warnings about hazards and extended data to other vehicles in the vicinity, the function uses technologies of wireless local area networks between cars. Vehicles can be used as senders, receivers and relay stations for that information. Other technologies using communication infrastructure can provide local hazard warnings with the help of extended floating car data too.
Lane Departure Warning	Warning given to the driver in order to avoid leaving the lane unintentionally. Video image processing is the most important technology. The system is based on the availability and visibility of proper road markings.

Lane Keeping Assistant	Active lane-keeping support through additional and perceptible force e.g. in the steering wheel.
Motorcycle Antilock Braking Systems (ABS)	ABS allows the rider to use the full braking capacities of his motorbike in emergency situations: it prevents wheels from locking and ensures bike stability and optimal deceleration. There are other advanced braking systems based on ABS, such as the CBS Combined Braking System. which are also put progressively on the market, starting from high displacement engines.
Obstacle& Collision Warning	System detects obstacles and gives warnings when collision is imminent. First solutions with limited performance are a separate feature of Adaptive Cruise Control systems, which use information obtained from radar sensors to give visual and acoustic warnings. Current systems use long range/short range radar sensors or in future also mid-range radar LIDAR and video image processing.
Emergency Braking	System detects obstacles and gives warnings when collision is imminent (see Obstacle&Collision Warning). In case that a collision will be unavoidable the system brakes automatically and forcefully, and may also activate measures of passive safety such as pretension the seat belts.
Run Flat Indicator / Tire Pressure Monitoring System	In case of an air loss in a tire the systems gives a warning to the driver. With the run flat indicator the system detects the different rotation speed of the tire which is under-inflated. In case of a tire pressure monitoring system the air pressure in each tire is directly measured and displayed if necessary.
Traffic sign recognition and alert	The function uses camera technologies and image processing to perceive the traffic-signs and give an alert about the content of the sign to the driver. The HMI is an important aspect for the information process.
Vision enhancement	Assistance function with camera techniques like infra-red which enhances the perception of pedestrians and other relevant objects at night or in otherwise bad vision conditions

*Table 2. Description of infrastructure related e*Safety *systems*

eCall	The emergency-call gives precise coordinates of the location of an accident and information about the vehicle to the emergency services which are responsible for the help. The service is a multi-stakeholder function of public organisations, telecom companies and service providers and car manufacturers.
Extended environmental information	Data from different sources of the vehicle e.g. switched on lights, windscreen wipers on, fog lights on, sensors monitoring the road surface (e.g. ice on the road), information from ABS, stability control systems can be used to create useful information about the environmental situation where the vehicle is driving. They are called extended floating car data, which can - after filtering - provide information about potentially dangerous situations at certain locations. These data are handled like floating car data (high quality congestion- / traffic information)
High quality Congestion/Traffic Information / RTTI (Real Time Travel and Traffic Information)	This is information to the driver about the traffic (congestion) and weather conditions for choosing the most effective route or for preparing to cope with the foreseeable situation ahead on the route. Important is the actuality of the information about the traffic situation to maintain the credibility of the function. The information is transmitted to in-vehicle and nomadic devices. Short-term forecasting is essential for these systems. Information can be personalised.
Infrastructure Based Warning Systems / Local Danger Warning	Warning systems about dangerous locations or situations do not necessarily have to rely on vehicle based technology. There are solutions which are only based on the infrastructure to warn the drivers. Spot-wise warning can be given via variable message signs, flashing or electronic beacons, radar based excessive speed information.
Speed Alert	The system alerts the driver with audio, visual and/or haptic feedback when the speed exceeds a limit set by the driver (speed limiter) or the legal fixed speed limit. The speed limit information is either received from transponders in speed limit signs, in-vehicle cameras with traffic sign recognition or from a digital road map, requiring reliable positioning information.
Dynamic traffic management	Influencing traffic flow by influencing speeds, lane use, route choice, merging operations by employing variable message signs (VMS) in order to improve safety and network utilisation. Applications include also e.g. ramp control, access control, tunnel control and closure. Three categories of VMS are identified: 'regulatory messages', 'danger warning messages' and 'informative messages'. Uses for motorway links, for network situations and for rerouting are also recognised as functionally separate domains.

The systems are based on a number of technologies as illustrated in Table 3. It is evident that several systems utilise and/or require the same technologies. Hence, it is cost-effective to develop and provide system and application packages, the price of which would be substantially lower than for getting each system or application separately.

*Table 3. Technology prerequisites for the e*Safety *systems. Green colour means that technologies are alternatives.*

	IR / LIDAR	Camera	24 GHz	Vehicle 2 Vehicle communication	other vehicle/driver data	Airbag/ CPU	wheel speed sensors	Steering sensor	GPS	GSM	Digital Map	PSAP	DAB/ TMC	VMS	Traffic detec-tion	Road wea-ther detec-tion	Inci-dent detec-tion
ESC					yaw rate, deceleration, brake actuation		X	X									
Blind Spot Monitoring		X	X		turn indicator signal		X	X									
Vision Enhancement		X (+ IR)					X										
Lane Keeping Assistance		X					X	X									
Lane Departure warning		X					X	X									
Driver Condition Monitoring		X			eye movements, operation of in-vehicle systems, …		X	X									
Map based Speed Alert							X		X		X						
Local Danger Warning				X	X				X	X	X				X	X	X
eCall						X			X	X		X					
Adaptive Headlights		X			turn indicator signal		X	X									
Obstacle and Collision Warning	X	X	X	X	X		X	X									
Emergency Braking	X	X	X				X	X									
Seat Belt Reminder*					belt status, passenger detection		X										
Run Flat Indicator							X										
Tire Pressure Monitoring					tire pressure sensors												
Autom. Headlight activation					light conditions												
Event Data recorder					driver input data, status of safety/assistance systems, deceleration	X	X	X									
Adaptive Brake Lights					deceleration		X										
Extended Environmental Information				X	X				X	X	X		X				
Dynamic Traffic Management				X					X	X	X		X	X	X	X	X
Infrastructure based Warning System														X	X	X	X
High Quality Congestion/Traffic Information / RTTI									X	X	X	X	X		X	X	X

The following aspects were considered for each system:

- Accidents / fatalities to be affected
- % change in accidents expected
- other side effects / comfort functions
- cost of in – vehicle systems
- cost for infrastructure systems (investments / maintenance)
- cost for information infrastructure (investment / maintenance)
- year of technical readiness
- year of implementation readiness
- user acceptance and willingness to pay for
- year of implementation by regulation
- specific implementation issues
- estimation of cars equipped with the system in 2010 / 2020
- other actors involved for implementation

It was found that not all of the questions raised could be answered. The competitive situation does not allow industrial players to unveil sensitive information before the market implementation of new functions and features. Some other questions can only be answered by dedicated studies and sophisticated research programs. Hence, not all fields in the table could be filled with appropriate data. So a more general way of ranking and evaluation of experts was used. After a ranking based on safety impacts, availability and possible market deployment, the Working Group selected a number of systems as priority systems. The priority systems are systems, which are expected to be able to reduce road fatalities in Europe already in the short- and medium-term. The priority systems are the following:

Vehicle-based systems

- ESC (Electronic Stability Control)
- Obstacle and collision warning
- Emergency braking
- Blind spot monitoring
- Adaptive head lights
- Lane departure warning

Infrastructure-related / based systems

- RTTI (Real Time Traffic and Travel Information)
- Dynamic traffic management (VMS)
- Local danger warning
- Extended environmental information / Extended Floating Car Data
- eCall [1]
- Speed Alert

Note that Emergency braking was added to the priority systems at the end of 2008.

The ESC and the Tyre Pressure Monitoring systems have been targeted for legislative activities. ESC and Tyre Pressure Monitoring will become compulsory equipment on all new motor vehicles in EU starting in 2012, with all new cars equipped in 2014.

[1] Automated emergency call systems include the public pan-European eCall systems as well as private solutions from different companies.

Emergency Braking and Lane Departure Warning will be mandatory for trucks in the year 2013. Due to the high market penetrations foreseen after the mandation of ESC, the Implementation Road Maps Working Group did not see any reason to include ESC in the priority list any more and decided to eliminate it from the list at the end of 2009.

3 BENEFITS AND COSTS OF THE PRIORITY SYSTEMS

Annex 1 presents a literature review of the safety impacts of priority *e*Safety systems including the results of the latest European research projects around these issues.

It should be noted that the accident data bases used in the studies so far are not optimal for the purpose of estimating the safety effects of intelligent vehicle safety systems. In order to facilitate more qualified assessments of the safety potential of *e*Safety systems, the European databases for accidents should be improved in line with the recommendation of the Accident Causation Data Working Group. First steps into the direction of a harmonised accident database were taken in the TRACE project.

A summary of the expected safety benefits of active safety systems according to research results is given in Table 4.

In addition to the direct safety benefits, the systems have indirect safety benefits in the form of reduced congestion as 10-18% of all road congestion in Europe is accident-related.

As eIMPACT and CODIA results indicated, the systems also affect traffic flow and thereby congestion, fuel consumption and emissions but these effects account for a very minor part of the benefits in comparison to the accident and accident-related congestion benefits.

The costs (i.e. not to be confused with the market price) of an in-vehicle priority system or component (in an infrastructure related system) were estimated to vary between approximately 50 and 200 euros by the eIMPACT project. The lowest costs were for Adaptive Headlights and the vehicle components of eCall, RTTI and Dynamic Navigation, and the highest for Blind Spot Monitoring and Speed Alert of the active gas pedal type.

The costs of implementing roadside VMS systems such as dynamic traffic management and local danger warnings depend on the location, the objectives of the system, the VMS signs, control system, required monitoring infrastructure, communication systems etc. The costs of route and network control systems on motorways are circa 200,000 €/motorway-km. The costs of a line control (speed management) system on a motorway can be estimated to be about 100,000 €/motorway-km and the investment cost for one VMS in a larger system could be around 25,000 €. The annual maintenance and operation of the systems can be 5...10% of the total investment costs.

Table 4. Expected safety benefits of the priority systems based on research results and expert assessments. More details can be found in Annex 1.

Priority systems	Accident type especially affected	Local results in specific conditions for effects on all accidents for vehicles or roads equipped based on research incorporating accident analysis
ESC	single accidents, loss of control, accidents on wet and slippery roads	injury crashes -7 to -25%; EU: -7% all fatal crashes -15 to -40% all fatalities -15 to -20%; EU -17%
Obstacle & collision warning	rear-end crashes	-
Emergency braking	rear-end crashes	all fatalities EU -7% all injuries EU -7%
Blind spot monitoring	side collisions	-
Adaptive head lights	accidents with pedestrians and cyclists on unlit roads	-
Lane departure warning	head-on or run-off-road, side collisions	injuries EU -2 to -6% all fatalities EU -5 to -10%
RTTI	accidents in adverse conditions, pile-ups	accidents in slippery conditions -5 to -15
Dynamic traffic mgmt (VMS)	accidents in adverse conditions, pile-ups	all injury crashes -5 to -20% all fatal crashes -10 to -25%
Local danger warning	accidents in adverse conditions, pile-ups	all injury crashes -1 to -15%
Extended environmental information	accidents in adverse environmental conditions	-
eCall		all fatalities -2 to -15%; EU -6% severe injuries -3 to -15%; EU -6%
Speed Alert	accidents caused by exceeding speed limits	all injuries EU -6% * all fatalities EU -9% *
Dynamic navigation	all accidents	reduced exposure but increased accident rate due to driving on lower category roads

* active accelerator pedal version

A FCD centre for managing and distributing extended environmental information has been estimated in the VIKING project at around 100 000 € to implement, in addition to annual operating costs of around 15 000 €. According to eIMPACT, all European PSAPs (Public Safety Answering Points) can be equipped with the infrastructure required by eCall at the cost of ca. 30 M€.

The benefit to cost ratios of some priority systems were estimated in the eIMPACT project.
The benefit-cost ratios in the forecasted 2010 accident situation were of the following approximate magnitude (in parentheses systems, for which a quite similar system was evaluated):

Electronic Stability Control	4.5
(Obstacle & collision warning)	2

Emergency braking	6
(Lane departure warning)	2.5
eCall	3
Speed Alert	2

4 PENETRATION OF THE PRIORITY SYSTEMS

The Working Group produced so-called simplified road maps describing the market penetration or deployment speed for two cases:

1) Business as usual and
2) Incentives and EU support.

The first case describes the current situation with no extra measures to accelerate the roll-out of *e*Safety systems.
In the second case, tax incentives, enhanced customer awareness programs, insurance gcompanies incentives for *e*Safety Systems, and EU support actions for deployment (e.g. TEN-T support) will be carried out, and standardisation will reduce prices due to economies of scale

The level of market penetration or deployment was estimated in the following categories:

- Very high 80 up to 100 %
- High 50 up to 80 %
- Medium 20 up to 50 %
- Low 5 up to 20 %
- Very low 0 up to 5 %

The estimates of the level of market penetration for priority vehicle-based systems are given in Table 5.

Table 5. Estimates of new car market penetration of priority vehicle-based systems in the "business as usual" and "implementation support" scenarios. Note that in the case of ESC, the business as usual has already contained implementation support.

Business as usual	% new cars equipped		
	2010	2015	2020
ESC	high	very high	very high
Obstacle & collision warning	very low	low	medium
Emergency braking	very low	low	medium
Blind spot monitoring	very low	low	low
Adaptive head lights	low	medium	medium
Lane departure warning	very low	low	medium
Implementation support	% new cars equipped		
	2010	2015	2020
ESC	high	very high	very high
Obstacle & coll.warning	very low	medium	high
Emergency braking	very low	medium	high
Blind spot monitoring	very low	low	medium
Adaptive head lights	low	medium	high
Lane departure warning	very low	medium	very high

The market penetration varies a lot between different car segments, being highest in the top-end models and lowest for smallest cars, for which the price of any system forms a much larger proportion of the car price than for larger cars. The market penetration also varies between countries

The estimates of the level of market penetration for priority infrastructure-related systems are given in Table 6 for cars and in Table 7 for the road network. It should be noted that the only reason for giving the estimates for the TERN is that currently European data on current and planned deployment only exists for the TERN. It is likely that the estimates correspond well to the situation on other major roads as well. More detailed information on the level of system deployment on the TERN is given in Annex 2.

Concerning the network equipped (Table 7), it should be noted that the most problematic and important parts are equipped first.

Table 6. Estimates of new car market penetration of priority infrastructure-related systems in the "business as usual" and "implementation support" scenarios.

Business as usual	% new cars equipped		
	2010	2015	2020
RTTI*	Low	medium	high
Dynamic traffic mgmt (VMS)	not applicable	not applicable	not applicable
Local danger warning	not applicable	not applicable	not applicable
Extended environmental info*	very low	low	medium
eCall*	very low	very low	high
Speed Alert	very low	very low	medium
Dynamic navigation	low	medium	high
Implementation support	% new cars equipped		
	2010	2015	2020
RTTI*	Low	medium	high
Dynamic TM (VMS)	not applicable	not applicable	not applicable
Local danger warning	not applicable	not applicable	not applicable
Extended environmental info*	very low	medium	high
eCall*	very low	low	high
Speed Alert	very low	low	high
Dynamic navigation	low	high	high/very high

**Note that the estimates do not take into account nomadic systems for functions like RTTI, Local danger warning, eCall, etc. This means that the number of cars equipped is underrated.*

Table 7. Estimates of TERN deployment of priority infrastructure-related systems in the "business as usual" and "implementation support" scenarios.

Business as usual	% of network equipped		
	2010	2015	2020
RTTI 1)	Low	medium	high
Dynamic traffic mgmt 2)	low	low	medium
Local danger warning 2)	low	low	medium
Extended environmental info	very low	low	medium
eCall	very low	very low	high
Speed Alert	very low	low	medium
Dynamic navigation	low	medium	high
Implementation support	% of network equipped		
	2010	2015	2020
RTTI 1)	Low	high	very high
Dynamic traffic mgmt 2)	low	medium	high
Local danger warning 2)	low	medium	very high
Extended environmental info	very low	medium	high
eCall	very low	low	very high
Speed Alert	very low	medium	high
Dynamic navigation	low	high	high/very high

1) % of network with sufficiently good quality RTTI
2) applies only to the problematic part of the network (probably around 20-30% of the network)
TERN: Trans European Road Network

The figures shown above apply to the fitment of new vehicles. A study of vehicle fleet compositions in numerous European countries revealed that the average age of vehicles is somewhere between seven and more than ten years. This means that a number of vehicles, which will be on the roads in 2010 and beyond are already in operation today. In other words, as only a few systems with noticeable impacts on safety are on the market today; especially Anti-Lock Braking Systems (ABS) and Electronic Stability Control (ESC), their impact would be rather limited. Other systems, such as adaptive cruise control systems, are currently only being deployed in the high-end sector of new vehicles and will take years to reach a significant market and especially fleet penetration.

Today, possible market penetration of new systems can only be calculated on the basis of rough assumptions. Simulations with different vehicle fleets and assumed equipment rates starting with low figures and assuming increasing equipment rates in the oncoming years led to the result that by 2010 only minor parts of vehicle fleets will be equipped with safety relevant ITS-systems. The SEISS study[3] estimated that in 10 years ca. 29% of the whole vehicle fleet of the 25 member states would be equipped with a system becoming standard equipment now. It should be noted that these estimates correspond to the "business as usual" case and do not take into

[3] Abele, J., Kerlen, C., Krueger, S., Baum, H., Geißler, T., Grawenhoff, S., Schneider, J. & Schulz, W.H. (2004). Exploratory Study on the potential socio-economic impact of the introduction of Intelligent Safety Systems in Road Vehicles. SEiSS. VDI/VDE Innovation + Technik GmbH and Institute for Transport Economics at the University of Cologne.

account the impact of government or insurance incentives, campaigns and other positive influences for better customer awareness of *e*Safety systems.

5 PROMOTION OF IMPLEMENTATION

Coming from the position of a market driven solution as the major element in deployment strategies, market demand is one of the most important issue. This in why the User Outreach WG was established, and due to its recommendations, the eSafety Aware initiative was created.

A starting point for campaigns was to have a clear message for the end user concerning a safety system available today. Therefore, eSafetyAware has been active in the promotion of ESC, through the “ChooseESC” campaign following some national campaigns of user organisations like e.g. ADAC in Germany. The campaign was launched in May 2007 by the eSafety Aware platform and its 37 member organisations. In 2008 alone, around 35 events and meeting supporting the “ChooseESC” campaign were organised in more than 15 countries including France, Greece, Slovakia, Slovenia, Switzerland, UK, Spain, Germany, Italy, Estonia, China, Canada etc. Several of the campaign activities included live demonstrations and hands-on driving experience with and without ESC. Since the launch of “ChooseESC!”, many personalities have given their support to the campaign. ”ChooseESC!” is planning to continue its campaign activities in 2010 to inform consumers about the importance of choosing ESC or other safety options when buying a new car, as long as such systems have not become standard equipment. Even then it is necessary to inform the customer about functionality, handling and benefits.

In terms of the international scene, eSafetyAware has established communication with Canada, Australia, China, and Japan regarding the global up-take of ESC. The organisation also assisted Transport Canada with the launch of an ESC campaign. The next functions to be promoted should be based on technologies, which observe the surrounding of the vehicle and detect objects to avoid or mitigate collisions by gaining additional time to react, to initiate emergency braking, or to prepare the vehicle before a collision might occur impact mitigation)

The deployment figures in this report again differentiate between “business as usual” and those with implementation support. The implementation support can, in addition to the eSafety Aware and other campaigns, contain other additional measures by different stakeholders. A very common measure is to have tax incentives or lower insurance rates for vehicles with eSafety or other systems with proven (financial) safety benefit. There are several projects and offers for the end user providing financial benefits if a specific fitment is ordered. For example, VW has offered better insurance rates if the selected model was fitted with ESC. Similar approaches exists also for HGV and ESC fitment.

Another comparable measure with eSafety Aware has been the introduction of a specific ranking within the EuroNCAP scheme. The difficulty in including active safety in the scheme designed for passive safety systems lies in preparation of an objective and relevant testing mechanism for the active safety systems.

Another very successful option is to organise campaigns mainly by system suppliers, to promote new systems. Suppliers are often not directly involved in the public market but play a key role in the whole context of business cases and market deployment. BOSCH as well as CLEPA have organized training for dealers, and public activities to bring end users close to technology solutions like ABS or ESC. Demonstration days and drive tests on drive tracks have been received very positively and will have a kind of multiplier effect, because people who are convinced once will speak about the system also to others. DVR has published a flyer and some other animations for the so-called " safe passenger" supported by ADAS systems. User organisations should be and also have been active, e.g. ADAC has raised the awareness for eCall via various communication channels.

In the future, the aforementioned actions will go ahead and additional measures will take place such as field operation tests (FOT). FOTs are expected to communicate the positive results to public and to rase public awareness for all involved partners: end users, dealers, governmental departments, and other organizations.

One promising option could be to focus the incentives and other support actions into such systems, which could stimulate the whole deployment via bringing to the vehicles or infrastructure some basic components used by many different services. This would hold for eCall and its GPS/Galileo and GSM platform and for all communication based or cooperative systems.

6 UPDATED IMPLEMENTATION ROAD MAPS

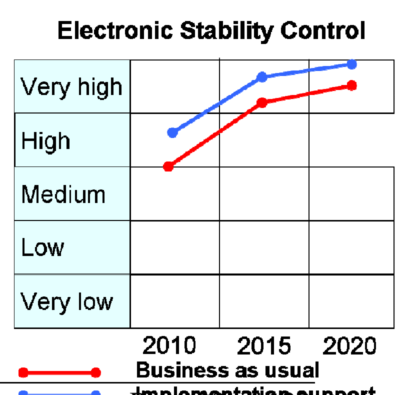
The implementation issues relevant for each priority system were identified and reported applying a common template with the following headings:

- System description
- Technology availability
- Road and information infrastructure need and availability
- Organisation requirements
- Regulatory requirements / barriers
- Business case / customer awareness and acceptance
- Key success factors
- Feasible deployment strategies

These implementation issue summaries are presented in Annex 3, and the main issues are discussed below.

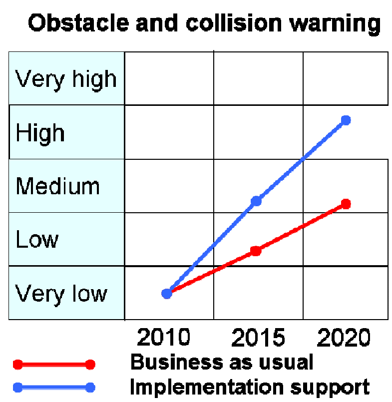
6.1 ESC

The general key success factor for ESC (Electronic Stability Control) is an increase of consumer awareness in a cost sensitive market segment. Studies on this topic have found that customers are becoming more interested in *e*Safety products than years ago, but there is almost a huge potential open especially in the lower car segment. Inclusion of ESC in the EuroNCAP system and the Choose ESC! campaign have enhanced consumer awareness.



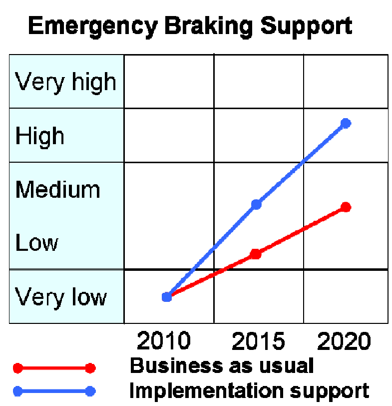
Government and insurance incentives would accelerate the deployment even more. The mandatory introduction of ESC in new vehicles in EC will increase the penetration greatly.

Obstacle and collision warning



A growing number of models are available with forward collision warning systems, mostly as a feature offered together with ACC systems. Customer acceptance is increasing as ACC systems are enhanced to provide more support in more traffic situations. So the added comfort functions of ACC will make it easier for manufacturers to sell such systems. Short, mid and long-range radar systems as well as LIDAR and/or video image processing are the technologies used at least until 2010.

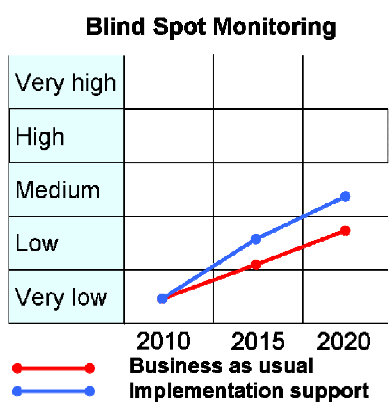
6.2 Emergency Braking Support



Based on radar (short and long range), LIDAR and/or camera vision several systems are already available that provide support in situations with a high risk of a head to tail collision in order to avoid the collision or to reduce the collision speed and the total crash energy. Total crash energy reduction correlates directly to crash injury mitigation. Different levels of support are available: enhancement of driver's braking if necessary, automatic activation of partial braking, automatic activation of full braking. Some systems also trigger reversible measures of occupant protection.

Consumer awareness should be improved by information campaigns.

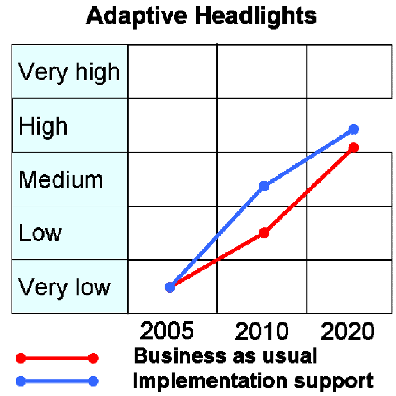
Blind Spot Monitoring



A first system based on video imaging has been available since 2006 integrated with other applications combining comfort and safety. Several other systems are now available that use short range radar (24 GHz).

Consumer acceptance might be further enhanced by campaigns that demonstrate safety and convenience benefits of this system.

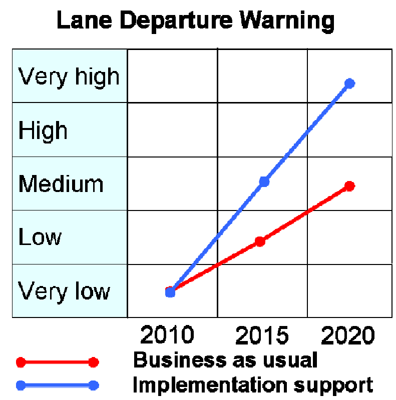
6.4 Adaptive Headlights



The system is available as an option in several European models. The total market for adaptive headlights is growing fast. Better headlights can directly be experienced by the drivers. The effects for road safety are probably acknowledged by the consumers.

Customer awareness and willingness to bear the additional cost entailed is improving. In Europe, manufacturers predict that 10% of cars produced in 2007 will feature AFS (Advanced Front light System). Experts estimate 50% of all accidents that occur at night are affected by insufficient visibility or lighting. Hence thepotential to reduce fatalities with the AFS technology.

6.5 Lane Departure Warning Systems



For commercial vehicles, systems have been available as extra fitment for several years. For passenger vehicles, some models are available with such a function.

As with all of the driver assistance systems, the user should be well aware of the capabilities of the system. Very often users have high expectations which cannot be fulfilled by the system yet.

6.6 Common issues for vehicle-based systems

Having in mind a market driven solution without a mandatory regulation, customer awareness is a key factor for the deployment of those *e*Safety systems. The additional cost of safety systems compared with other comfort systems is also a major aspect. Business cases for OEM, supplier and also dealer and vehicle owner have to be positive.

According to Züricher Versicherungsgruppe, the costs of accidents which can be affected by *e*Safety systems is about 15 billion € each year in Germany. For the EU15 countries the total cost of accidents is estimated to be ca. 160 billion € / year. The costs for advanced surrounding perception are significant. Overall, the business case has to be positive. One of the major issues in cost discussions is in some cases the unbalanced allocation of costs and benefits for the involved parties. Most of the business cases are positive for the society but not in all cases for the user or vehicle manufacturer. It is essential to develop a well balanced model in order to accelerate the roll-out of the systems.

A detailed European accident database, which will enable the evaluation of the possible impact of different *e*Safety systems better than today, would make decisions in this field much easier.

Internationally accepted consumer information by EURO NCAP about ESC and other active safety systems would increase the awareness of customer positively.

Incentives given by Governmental departments or / and insurance companies will also be necessary for an increasing number of *e*Safety systems on the fleet.

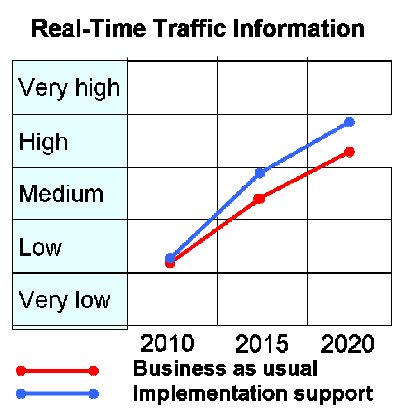
For most *e*Safety related functions on vehicles, the updated European Statement of Principles (ESoP) for HMI (Human machine interaction) is important. The updated EsoP contains more precise advice than before on:

· Compliance with ISO standards, rules and directions
· System installation
· System information
· Nomadic devices
· Service provider/Fleet manager/Owner and Employers

Safe use of those systems over the full lifecycle of the vehicle is essential, while manipulation of the functions needs to be prevented. The eSafety Forum's eSecurity Working Group is working on these issues.

All systems have a considerable potential to save lives. A precondition for acceptance is to assure the required robustness, which leads to the "limitation" that these systems will not intervene in all theoretical feasible critical situations. Open legal issues (e.g. the issue of driver responsibility with automatically activated systems) must be solved taking into account all current regulations such as the Vienna convention.

6.7 RTTI



The provision of real-time travel and traffic information of inter-urban and metropolitan traffic to the majority of drivers requires a number of actions. One of these is that the road administrations and ministries as well as the private operators in the member states of the EU should extend the introduction, the use and the application of the existing methods such as RDS/TMC. The main issues as identified by the RTTI working group are the limited availability of traffic information content especially in urban areas, difficulties in defining the roles of the public and private sectors, the cost of broadcasting, the limited data rate in FM radio, and the economic difficulties with business models.

The member states should
- agree at their national level on a strategy and time schedule for the implementation of RTTI services, starting from RDS/TMC, covering as good as possible both interurban and urban areas

- support the Traveller Information Services Association TISA to push the safety-related services features of TMC, building on the already existing, standardised European format for the data, messaging and transmission standards,
- take steps to ensure roaming and interoperability across the RTTI services in all of the EU member states,
- require the authorities to make available existing public data for the provision of RTTI services and to establish additional collection of RTTI when necessary,
- agree, on the basis of the national RTTI strategies, the Commission Recommendation on TTI services and the EU ITS Action Plan, with the private service providers on the minimum extent of the public (free of charge) services and the conditions for the commercial services, and establish public-private partnerships if necessary,
- ensure the correct implementation for the standards by the service providers,
- publish, following the guidance of the Commission RTTI recommendation, clear guidelines for the private sector concerning the conditions for establishing private data collection networks for commercial purposes,
- require broadcasters, especially those operating under public licence, to carry the RDS/TMC traffic information on their FM services for public or private providers so that a minimum of 80% of journey drivers has access to a relevant service in 2010,
- require authorities to ensure through the appropriate standardisation and regulation bodies that frequency spectrum and broadcast capacity will be made available for the more advanced digital broadcast services such as DAB, DRM, DVB-T and eventually satellite-DAB,
- support the development of more advanced services which are possible by 3G Mobile Communications, DAB, DVB-T and satellite broadcasting, WLANs and others.

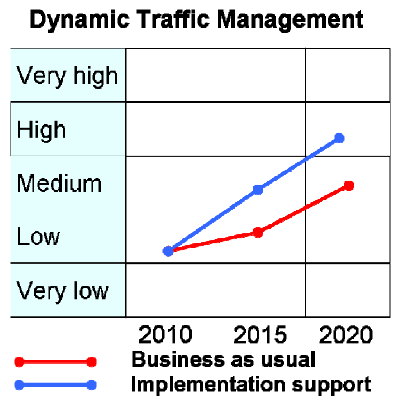
The customer's awareness and interest in the RTTI-service can be augmented with more and more actual and correct traffic information, not only warning for traffic problems but giving information of the end – or even the expected time for end – of a traffic problem, extension to inner-urban traffic information, eventually extra features such as expected travel times and reasonable costs. In order to accelerate the deployment of RTTI services, the authorities should provide existing RTTI data to the operators and broadcasters, and give support and allowances for private data collection and service provision – especially when public organisations and communities show little or no interest to provide an adequate RTTI service.

6.8 Dynamic traffic management

The technical implementation issues related to dynamic traffic management systems using Variable Message Signs (VMS) are mainly related to the need for some pictograms that could contribute to the optimisation of road availability and traffic flows distribution particularly at the local level, and to some extent at the regional level. Examples are lane allocation, hard shoulder use, rerouting, road-exit closures, and congestion on road-exit related to road-exit availability. VMS harmonisation, particularly when achieved with the new full-matrix VMS, could act as a transference design platform to in-vehicle devices, particularly with regard to messages concerning official information related to safety and mobility. This would also affect the harmonisation of in-vehicle displays.

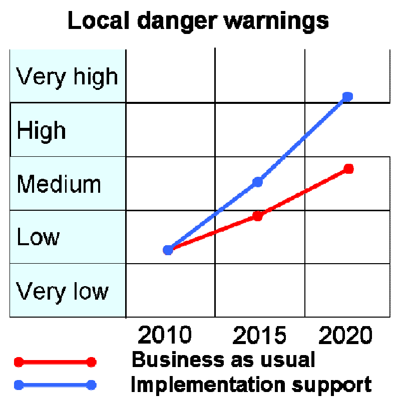
There are also communication and sensing issues in the use of vehicles as mobile sensors in provision of information required by traffic management. The use of data from in-vehicle systems to improve the quality of the monitoring systems will require new organisation-related solutions. European harmonisation has taken place and should be continued within the scope of the TEN-T programme of the European Commission. TEN-T programme support is also important for acceleration of the deployment of the dynamic traffic management systems on the TERN.

There are considerable costs involved in the implementation of dynamic systems. A key success factor is to maintain and improve the effectiveness of the systems while keeping costs at a reasonable level. The former is ensured by high quality of the systems and high user acceptance enabled by the efficient and understandable control of the VMS and supported by the harmonised deployment of them on the European level. The latter is supported by the increasing use of mobile, in-vehicle based systems for producing the necessary traffic and environmental information required.



The road authorities and operators should develop together a European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with the vehicle and telecommunications industry and other involved parties, possibly on the basis of new PPP models. In the development the central organisations CEDR (Conference of European Directors of Road) and ASECAP (= European Association of toll road operators) play an important role, and EasyWay involving key stakeholders from both organisations is the optimal development and deployment platform.

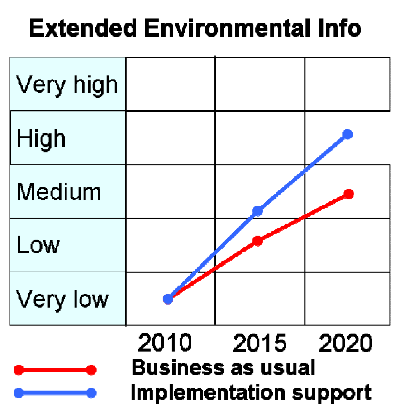
6.9 Local danger warnings



The technical implementation issues related to local danger warnings using Variable Message Signs (VMS) as well as communication and sensing issues in the use of vehicles as mobile sensors in provision of hazard information. The VMS issues include missing pictograms as fog, rain, snow, unauthorised person on road, on-coming vehicle, etc., and the need to achieve two different reactions for the part of drivers depending on 1) whether the danger is near and immediate or 2) whether the danger is still far away. The introduction of danger warning pictograms without the read triangle has been proposed to provide pre-warnings (e.g., road works expected tomorrow on the road in question). For that, drivers must somehow learn that typical danger pictograms without red triangle are not implying immediate danger.

The same issues and solutions for harmonisation, costs, need for TEN-T programme involvement and common European strategy as with dynamic traffic management systems also apply to local danger warnings. The co-operation with the vehicle and telecommunication industry are, however, even more central with local danger warning systems due to the presentation of warnings via in-vehicle systems and the need for quick transmission of hazard warnings.

6.10 Extended environmental information



The main problems of extended Floating Car Data (FCD) are related to institutional and legal issues. Use of the system requires centres, which receive and fuse the data from various sources and prepare the actual and precise information of local hazards, traffic and road conditions (slippery roads, fog etc.). There should also be an organisation defining standards for the in-car equipment and an organisation to take care of the overall maintenance of the system. The same organisation could also be responsible for the further development of floating car data system. An organisation is also needed to deploy and maintain local transmitters and/or receivers to collect/distribute FCD and local information as well as to maintain the real-time data pool. In most cases a public service actor needs to be involved e.g. via a Public-Private-Partnership (PPP).

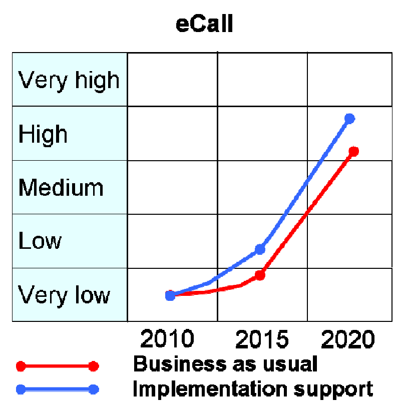
In order to avoid the development of further proprietary systems, it is necessary to set up standardization committees in early development stages. The ISO International Organisation for Standardisation in its Working Group TC 204/Subworking Group SWG 16.3 for vehicle probe data for wide area communication is working. Their work item proposal contains “Architecture, Basic Data Framework and Core Data Elements”. The Standard is finished: Vehicle Probe Data for Wide Area Communication, ISO 22837

Legal issues to be solved include data protection and privacy issues concerning individual vehicles as well as issues related to the ownership of the data collected.

Intelligent message management and feedback channels minimise data transmission costs and ensure validity of real-time data. A working business model can probably be built upon payments from road operators and authorities for the data for their traffic management purposes and providers of real-time services (such as prediction of travel times) offered to the public.

The real-time status of the road network can be assessed with reasonable accuracy with about 5-10 % of cars equipped with in-car equipment used to collect FCD. This requirement is easier to meet when the geographic area is limited. Before the large-scale deployment the technological solutions for data collection and fusion as well as business models should be tested in practise.

6.11 eCall



One of the most complex systems is eCall as it involves all the stakeholders of the complete rescue chain. The eCall Driving Group (ECDG) has developed a comprehensive roadmap for integrating the eCall functionality in each new (type approved) vehicle from a certain point in time onwards, depending on the progress made from now on. The complexity of the implementation is given through the different institutional arrangements required in each Member State due to differences in delegation of responsibilities for managing emergency situations. There are also differences with the technological equipment available at today's PSAPs (Public Service Answering Points) and their capability to manage eCall data. Furthermore emergency services across Europe are not the same as they have grown organically over decades.

For European technical interoperability, a common system architecture with standardized interfaces and protocols is recommended to create necessary economies of scale and allow efficient cross border services. Under a clear European roll out and implementation plan and commitment the roll out should, therefore, start with the major European markets and the "Early Adopters", should be sufficiently tested and the infrastructure should be made available in all countries according to the agreed implementation plan.

The ECDG identified an annual saving potential of up to 25 bn Euro in the health and social cost area, which more than covers the cost of in-vehicle equipment and infrastructure upgrades. In so far, the business case is principally clear, the problem, however, is how, when and by whom will the cost be financed? This requires a political solution. A new eCall assessment study has been launched by the EC to investigate the market introduction of eCall across Europe, the legal and liability

issues, the costs and benefits of the service and to assess three specific policy options:
(1) Do nothing,
(2) eCall introduction through voluntary agreement supported with public sector campaigns and other actions, or
(3) Mandatory introduction by regulation.

The results of this study are not yet available but progress has been made with the ITS Action Plan & Directive, where eCall is one of the key actions.

The EC has also launched a study in 2008 to develop a VIN decoder software available to the PSAPs. First results were presented at the 17 September 2008 High Level meeting on eCall. While the software is basically working the biggest issue is on how to get Vehicle Identification Numbers (VIN) from all manufacturers, how to update the information on a regular basis, where to file the information and how to ensure authorized access only.

Low interest of drivers and customers result from low awareness of the benefits of a standard in-vehicle eCall and the general overestimated imagination that the own risk is rather low. Furthermore, professional cost-free emergency services exist today resulting in the view that in-vehicle emergency systems, especially when based on 112, should also provide a service free of charge to the driver.

At the end of 2009, 16 EU Member States and three EFTA countries have signed the eCall Memorandum of Understanding (MoU). In total almost 100 companies and associations have signed the MoU. All details can be found under the *e*Safety Programme Office Web Site (www.esafetysupport.org).

Under the leadership of the Commission several meetings have taken place with public and private service providers, insurances, mobile network operators, etc. to reach a common understanding and agree on the roadmap for eCall. Currently ETSI has taken on the task to define the transport protocol and standardize a public emergency service across Europe, while CEN defines the Minimum Set of Data (MSD) and the Operational Requirements for the public eCall service as well as for a private eCall Support Service, which could run a parallel and/or as support of a public eCall. Results were expected already in 2007, but the standardisation process had encountered a significant delay, especially in the transport protocol selection, mainly due to the fact that no proposed solution fully complied with the eCall requirements early defined by the ECDG. However, important progress has been achieved in 2008 and especially in 2009. At CEN level the MSD content has been agreed and the Public eCall Operational Requirements are defined and in the ballot process. At ETSI level, consensus on the eCall Flag has been achieved and, most important, the selection of the transmission method has made a major step forward: at the end of the selection process lead by 3GPP, which involved different in-band modem solutions being tested against the eCall major requirements, A final decision to confirm the technology has been taken in December 2008. Details were finalised by March 2009. The Commission has also endorsed a five-month project to define a High Level Application Protocol. The results are also currently in the final approval process.
A field operational test has been planned to further proof the functionality of eCall under the standardized and agreed solution. The availability of a final solution on MSD, operating requirements for (public) eCall and (private) eCall support services

has to be aligned with the start of the field operational tests. This test is expected to be carried out within the scope of the TeleFOT project. While TeleFOT has started, the section on eCall is still waiting for the finalisation of the standards to be tested.

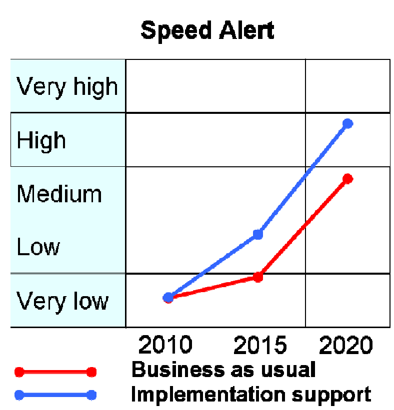
According to the three year lead time (after all specifications are determined) – as claimed by the automotive industry – the original roadmap of introducing eCall as a standard option for all new type approved vehicles after September 2010 is no longer achievable. How fast eCall can now be offered, depends on the basic decision if eCall will be mandated (see ITS Action Plan & Directive) or offered as a "standard" option in all vehicles 3 years after the end of the standardization process (including official approvals) , on the first results from the FOT, the availability of a feasible and fair business case for all stakeholders as well as a strong commitment from the European Member States. Currently it looks as if the introduction of in-vehicle systems needs to be delayed at a minimum to the beginning of 2013.

In order to encourage a more active involvement of the EU Member States (or at least of those who have signed the MoU) in the eCall deployment process at European level, the EC have created the European eCall Implementation Platform (EeIP), which works through:

- The definition of guidelines for implementation
- The establishment of national and/or regional eCall deployment platforms
- The follow-up of implementation at national-regional (cross border)-European level
- The exchanges of best practices
- Potential pilot programme to be supported by the EC.

This Platform has started its activities in the beginning of 2009 and has defined a significant number of activities, which are currently processed or already finalized.The list of Actions can be found in the Annex.

6.12 Speed alert



A number of open questions exist related to speed alert such as voluntary or mandatory equipment of vehicles, type of speed limits, road categories or road sections to be included, types of vehicles to be equipped and categories of road users to use speed alert. Suitable solutions need to be achieved, for example: how to convey speed limit modifications to the data bases of on-board units (OBUs), electronic Map on CD-ROMS, local short range communication, wide range communication (DAB). The basic information infrastructure required by the system, i.e. up-to-date fixed speed limit information in digital road map, needs to be made available in Europe, but is currently only available for all roads in Norway, Finland and Sweden, and limited to motorways and main roads for a large part of Europe. The fixed speed limit information should be complemented with dynamic and temporary speed limit information. The institutional and legal issues related to data quality requirements, questions of responsibility, liability, updating, timing of the updating, legal relevance of speed alert systems and speed limit signs as well as their possible contradictions and necessary business cases are among issues, which need to be solved. Currently, European road authorities and map providers work together in the ROSATTE project to develop a harmonised exchange platform to improve availability and accessibility of speed limit information for optimal integration into digital maps. This initiative is also supported through the ITS Action Plan priority "Optimised use of road, traffic and travel data". Most portable navigation systems are providing speed limit information and many also offer a speed alert functionality showing to what extent the current speed of the vehicle differs from the posted speed limit.

Several vehicle manufacturers are using camera-based traffic sign recognition technology that can read traffic sign (speed limits and other traffic restrictions) and display the information on the dashboard, and this is another basis for speed alert and similar services.

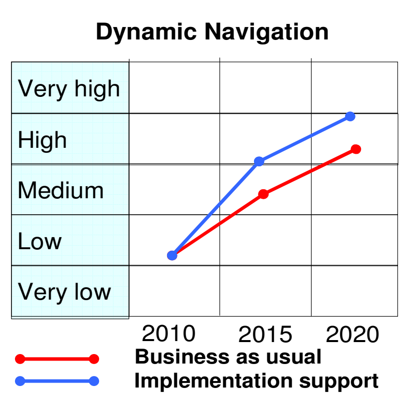
The demand for speed alert is expected to increase among authorities and transport operators due to safety concerns and among drivers due to increased automated enforcement of legal speed limits. The large-scale implementation in the short-term will depend on European and national regulations aiming at mandatory or voluntary deployment of the system. European and national decision making will, however, require that the open questions will be settled. A first but decisive starting point would be the correct collection, timely update and access to or provision of (national) speed data.

The SpeedAlert project developed the European wide deployment strategy for voluntary in-vehicle speed alert systems by establishing a common classification of speed limits in Europe, defining the system and service requirements of in-vehicle speed alert system, defining the functional architecture of speed alert, harmonising the definition of speed alert concepts and identifying the requirements for standardisation. The project defined recommendations and an associated deployment roadmap for a successful European-wide implementation.

It is quite likely, that deployment has to build on voluntary systems. In a longer perspective, mandatory systems could be deployed for certain customer groups, such as learning drivers, frequently caught speeders, drivers wishing for insurance bonus etc., if this is regarded as feasible and beneficial.

6.13 Dynamic navigation

Dynamic navigation uses current traffic data for adjusting the routing process with electronic navigation systems. This enables users of dynamic navigation technology to avoid routes with accidents, roadwork, road closure, and overall traffic jams in "real time". Such an advanced navigation system is able to reduce traveling times, fuel costs, emissions, and the



overall driver's stress level. There are also safety related benefits as comprehensive deployment of systems for dynamic navigation could balance the volume of traffic as well as inform drivers about traffic jams and other hazardous situations in real time.

Today, the advanced technology for dynamic navigation is available in commercial channels with additional payment. However the set of traffic related information that is available free of charge is not able to provide a basis for interactive, well-functioning dynamic navigation processes. In addition to that, not all European countries have such free of charge TMC (traffic message channel) services. Therefore improvements in terms of content and coverage are needed in order to start establishing dynamic navigation that works across Europe.

Commercial providers such as car manufactures and PND (portable navigation device) manufactures already have systems and infrastructure in place, which would allow dynamic navigation with the benefit mentioned above. These systems do not work with RDS networks but use cellular networks and therefore have two-way connectivity that facilitates very accurate traffic information for optimised route guidance as well as additional services such as LBS (location based services) or community services.

Since the product life cycles and the corresponding development phases of PNDs are typically shorter than those of the in-built navigation systems, latest technology with regards to dynamic navigation will be first and foremost available on PNDs in the future. This needs to be considered when striving for a high market penetration of dynamic navigation, which is necessary for deployment and high customer acceptance. This theory is also backed by recent research from Berg Insight which predicts that more than 80 percent of all PNDs sold in 2015 will have cellular connectivity and therefore permits dynamic navigation.

To raise customer awareness for dynamic navigation, it is necessary to establish cross-border TMC functionality based on RDS networks first, and then improve the traffic information services in terms of quality. After these steps the system of dynamic navigation then needs to be finalised by changing to a high-capacity communication network.

6.14 Systems for heavy duty vehicles

Because of special implementation issues, different system solutions and also different accident analysis, the working group for Heavy Duty Vehicles was established. This working group identified the following priority systems, after ranking and evaluation of effectiveness, costs, availability and customer acceptance:

1. Tire Improvement
2. Emergency Braking Systems
3. Emergency Braking System incl. Stationary obstacles
4. Emergency Braking Systems incl. Upcoming traffic
5. Vulnerable Road User Protection System
6. Extended Flexible Under run Protection Systems
7. Inter Vehicle communication
8. Intersection Assistance (infrastructure based)

9. Interactive Driver Training

More detailed results can be found in the final report of the Heady Duty Vehicles working group.

6.15 Systems for motorcycles

Although the total number of fatalities by traffic accidents has been reduced in the past years, the number of motorcycle fatalities has either increased or remained constant in both developed and emerging countries. In total, motorcycle fatalities account for about 16% of fatal road accidents in the EU. Hence, the prevention of motorcycle accidents remains of one of the major EU road safety challenges.

Safety systems have been developed and gradually fitted to motorcycles. The most common is anti-lock braking, ABS, which is considered by experts as the safety technology that has the highest accident reduction potential for motorcycles. ABS allows the driver to use the full braking capacities of his vehicle in emergency situations: it prevents wheels from locking and ensures bike stability and optimal deceleration. In order to avoid locking of the wheels, speed sensors at both wheels monitor the accurate speed of rotation. If a wheel blocking occurs due to over- or unbalanced braking, the ABS hydraulic unit corrects the braking pressure and prevents the blocking. This preserves the gyrostatic effect of the wheel and keeps the bike stable. Even an inexperienced driver can thus now achieve the the best deceleration possible without incurring any risk.

Currently, the ABS average fitment rate for motorcycles >250cc produced in triad countries is about 14%. ABS is mostly sold as an option. Concerning two-wheelers <250cc, they are very rarely fitted with ABS.

Other advanced braking systems, such as CBS Combined Braking Systems, are also put progressively on the market, starting from high displacement engines.

The effectiveness of motorcycle ABS to avoid or mitigate serious and fatal accidents under real driving conditions has been analysed and proven in several European and international studies. A recent study by the German Federal Highway Research Institute (BASt) shows that a 100 percent installation of a motorcycle ABS could avoid approximately 12 percent of both fatal accidents and accidents with serious injuries for all motorcycles above 50cc, resulting in an avoidance potential in Germany of 97 fatalities per annum (BASt, 2008). A study by the Allianz Center for Technology (AZT, 2005) on severe motorcycle accidents shows that between 8 and 17 percent of severe accidents with injuries and fatalities could have been avoided if the motorcycles were equipped with ABS. A reduction of approximately 100 fatalities and over 1,000 severely injured per annum could be expected for Germany. An accident research project for two-wheeler accidents from the Saarland police department came to the conclusion that approximately 20 percent of all motorcycle accidents (>125cc) with injuries and fatalities could be avoided thanks to ABS (Brutscher/Priester, 'Unfallforschungsprojekt Zweiradunfälle', 2005). Another study in the US, published by the Insurance Institute for Highway Safety (IIHS) in conjunction with the Highway Loss Data Institute (HLDI), shows a 38 percent decrease in fatal crashes and a reduction of insurance claims of 19 percent for motorcycles fitted with ABS (IIHS, 2008).

MODEL FOR A CONTINUOUS MONITORING PROCESS

The chapter deals mainly with the monitoring process concerning the deployment of the priority systems in Europe.

7.1 Instruments

Numerous statistics exist on the European level, e.g. by Eurostat (http://epp.eurostat.ec.europa.eu), but these do not include the information on the market or fleet penetrations of in-vehicle systems nor the infrastructure coverage of infrastructure related systems with few exception like e.g. the penetration of in-vehicle navigation systems. However, when it comes to penetration by model or even by brand, information is not publically available.

As safety systems are competitive products OEMs do not publish penetration rates of such products.

One way is to request market penetration data from First Tier Suppliers to OEMs, especially those with an additional interest to sell such products and applications to the aftermarket or have an interest to increase the sales of their products through higher customer awareness and related demand (promotion of ESP/ESC through Bosch is a good example). In this case even information available on penetration rates per car category (mini, small, medium-sized and premium car segment) would be valuable.

. On the basis of the experiences so far, surveys seldom produce data of sufficient coverage. Personal interviews, on the other hand, are quite costly and only give a spotlight or a personal estimation.

Interviews are made even more costly due to diffused responsibilities for monitoring and reporting the deployments on the national and European level.

For in-vehicle systems, automobile and device manufacturers are well aware of the sales and penetration of their own products but ,as said before, are usually unwilling to make such information public and available to their competitors. National vehicle registration authorities are one source of information, but they do not register the installation of all of the eSafety systems in a consistent and comprehensive manner throughout EU27.

Concerning infrastructure related systems, the road operators are the most reliable source of information concerning the infrastructure coverage, but again aware only of their own infrastructure. For the Trans European Road Network, the Euro-Regional projects and their follow-up, EasyWay, is a quite good source of information up to 2013.

The European ITS Action Plan and the proposed Directive accompanying it indicate that the EU member states are expected to report on the deployment of ITS systems (including eSafety systems) periodically to the European Commission. This would be the optimum source of the monitoring information also with regard to eSafety Implementation Road Maps. Member States, however, can only report on fleet penetration when they receive adequate information from the manufacturers. It can be expected, that Member States will fulfil their obligations by just reporting general penetration rates.

7.2 Updating schedule

The deployment should be monitored preferable on an annual basis. The Directive proposal (*Directive…laying down the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other transport modes;* COM2008(887), 16 December 2008) requires that all Member States should provide annual detailed reports of ITS service/system deployments starting two years after the adoption of the Directive. In practice this means reporting in late 2012.

7.3 Responsibility and financing

If carried out alongside the ITS Action Plan monitoring process, the basic responsibility for data collection lies with the Member States and the responsibility for specifying the data collection framework and analysing the data lies with the European Commission, which means what ??????

7.4 Modelling process

When compiling and collecting deployment information, usually information is available on the equipment of new vehicles as well as new investments in the road and information infrastructure. For the latter, the estimation of the total infrastructure coverage is quite straightforward by adding the new coverage to the existing one. For vehicle systems, the estimation of the fleet penetration needs to consider the market penetration of new vehicles now and in the past years as well as the age distribution of the vehicle fleet. In some cases, such as in determining the impacts of the systems, it is useful to investigate the "vehicle kilometer" penetration also. This requires that fleet penetration rates of cars of different ages are weighted by the average distance driven in each vehicle age group. The actual methods have been developed and utilised by the EU project eIMPACT, and described in more detail in their deliverable.[4]

7.5 Template of the periodic report

The periodic report should contain the following information for vehicle systems:

[4] Wilmink I., Janssen W., Jonkers E., Malone K., van Noort M., Klunder G., Rämä P., Sihvola N., Kulmala R., Schirokoff A., Lind G., Benz T., Peters H. & Schönebeck S. (2008). Impact assessment of Intelligent Vehicle Safety Systems. eIMPACT Deliverable D4. Version 1.0 April 2008.

Instalment of factory installed systems in new vehicles in country NAME OF COUNTRY in year 20XX. Numbers of new vehicles registered during the year equipped with the system.

System	Cars	Light Goods Vehicles	Heavy Goods Vehicles	Buses
Electronic Stability Control ESC				
Blind spot monitoring				
Adaptive head lights				
Obstacle & collision warning				
Lane departure warning				
Emergency braking				
eCall				
Extended environmental info (X-FCD)				
RTTI				
Speed Alert				

Sales of aftermarket or nomadic systems for vehicle use in NAME OF COUNTRY in year 20XX. Numbers of devices including the system.

System	Cars	Light Goods Vehicles	Heavy Goods Vehicles	Buses
Obstacle & collision warning				
Lane departure warning				
eCall				
Extended environmental info (X-FCD)				
RTTI				
Speed Alert				

Coverage of road network or information infrastructure in NAME OF COUNTRY in year 20XX with systems (%).

System	Trans-European Road Network TERN	Other main roads	Critical spots requiring local warning	PSAPs
eCall (PSAPs equipped to receive)				
Extended environmental info (X-FCD)				
RTTI				
Dynamic traffic management				
Local danger warning				
Speed Alert				

8 RECOMMENDATIONS

8.1 Review of earlier recommendations

The recommendations given in basic report (2005) are in principle valid even today, but some elements could be added, because of new ongoing events and possible new initiatives. The most apparent problem concerning the eSafety actions is - as previously pointed out - the slow implementation rate concerning the existing - applications and services. This is partly being addressed in the ongoing Field Operational Tests, where a successful outcome will be a strong motivator for raising awareness among the key potential customer groups.

In addition, the eSafety implementation study 2007 clearly shows a large span in the eSafety implementation rates between the north and south of Europe. This can partly be explained by the fact that most new passenger cars in for example Denmark and Sweden are purchased by companies to be used by their employees. This means that the company has, on one side, a responsibility for the safety of their employees, on the other side company cars are quite often part of the status of the employee (management) and , therefore, part of their contract structure. This makes this group of customers more inclined to purchase the latest technology that increases his safety without being too sensitive about additional costs.

The second movement towards an increased implementation rate could be triggered by the automobile manufactures influencing the sales organisations to promote and advertise the advantages with eSafety installations in new vehicles. The sales organisations have so far shown a very limited involvement in the promotion of eSafety systems, partly resulting from a low level of awareness among the sales personnel. The increased involvement of these parts of the sales organisations would be a very important addition to the existing recommendations. In reality this is easier said than done. OEMs spend huge amounts of money for the training of dealer personnel; sales people are no exception. Safety systems are very complicated not only to explain but to be understood by the simple mind of many customers. Complicated explanations delay the purchase process or even risk a positive outcome. The approach to sell more safety products, therefore, needs to be multi-fold. Well-informed dealers and informed and curious customer to ask for safety devices. Moreover, training cost money, not only for the OEMs but as lost working time for the dealers. Therefore, not all salesmen could be sent to training. At the same time and those coming back from a course are reluctant to share their new knowledge with others for various reasons.

The principle - as was shown in the previous recommendations - to concentrate on existing technologies and applications and prioritise their deployment compared to the addition of new technical solutions is to be maintained in the new version of recommendations.

8.2 European Commission

The recommendations concerning the European Commission are listed below.

1. The European Commission should investigate how to better collect and make the data on the availability of eSafety systems in a vehicle available (anonymously) without affecting the valid interest of individual company with regard to competition. The data collected by these systems then should be made available for accident research and vehicle inspection purposes across Europe. The option should be evaluated to get the installation of eSafety systems in vehicles by a European data base, containing all manufactured vehicles, by their VIN number, as part of the registration papers or in the Certificate of Complicance or on a bar code acsessable by inspection services , or by other means to increase the quality of existing data bases concerning accident analysis.
2. The European Commission, together with the Member States, industry and all other stakeholders, should continue promoting R&D to improve existing safety applications and to develop new and better safety systems. Research should also continue on co-operative (vehicle and infrastructure) systems, especially on applications dedicated to safety and energy efficiency. Improvements on existing systems through the addition of V2V and V2I functionality should also be explored.

3. Steps towards deployment should be financially supported by the European Commission within their Framework Programmes through Field Operational Tests (FOT's) and CIP pilots considering appropriate and feasible sustainable business models for each application. In specific cases, it may be necessary to establish PPP's (Public-Private Partnership) arrangements between public authorities and private companies.

4. The European Commission should continue to support the standardisation and harmonisation activities required to to facilitate a pan-European deployment of road safety solutions and systems.

5. A number of infrastructure-based and co-operative solutions require improvements in the infrastructure.. Although such investments depend essentially on the Member States, the European Commission should pave the way for having such steps taken and promote synchronised actions through the instruments at their disposal (e.g. ITS Action Plan, EASYWAY project, TEN-T programme) and using new methodologies like Lead Markets (increase the willingness of countries and regions to take on the role as “early adopters” for *e*Safety systems) and Pre-Commercial Public Procurement.

6. The European Commission should support European campaigns to enhance the customer awareness of the safety benefits of safety systems, and motivate Member States and insurance companies to give fiscal/ financial incentives to customers to buy vehicles equipped with such systems
7. The European Commission should take the necessary actions to ensure that digital maps containing the information required by the *e*Safety systems will be developed for all roads in the Member States as an important basis for the deployment of priority services like eCall, RTTI and Speed Alert. Here, the Commission should follow, among others, the recommendations of the corresponding eSafety Forum Working Groups.

8. The European Commission should consider regulatory actions, such as making systems mandatory equipment in new vehicles only when such action is judged as essential and beneficial for both industrial and public stakeholders. Voluntary solutions should be favoured.

9. Actual systems might become the object of further integration and improvements towards increasingly (half-) automated driving. Safety will be enhanced, fuel consumption and environmental impact will be reduced, while the energy efficiency and the use of existing capacity of the transport system will be improved. However, the European Commission should assess a number of issues that need to be addressed:
   - Standardization of communication channels, protocols and services across Europe;
   - Standardized equipment of intelligent road infrastructure across Europe;
   - Continuity of services and equal level of service quality all over Europe, across boundaries and modes of operation;
   - Safety responsibility/liability with respect to the interpretation of the Vienna Convention (need for critical revision); and
   - Development of sound and fair business cases that are attractive for all involved parties.

8.3 Member states

The past 10 years we have had an increasing safety and effectiveness of road transport. We also have a wider common understanding of what is important in the future with regard to different measures affecting safety and effectiveness, and recently more importantly, the link between mobility and the environment. Still, most of the recommendations of the Implementation Road Maps Working Group from 2005 and from its updated versions from 2007 are valid. Nevertheless, there is a lot to do and there is still a high potential for more road safety development in the future. The reason is that many of the effective solutions have not reached the stage of large-scale deployment.

Concentration on a few but available solutions in combination with very wide support from all important stakeholders is likely more effective than having a big bundle of good ideas but not enough resources to put them into force or promote them. Wide support is always available if there are, in addition to the positive safety effect, other benefits such as higher comfort or lower fuel consumption due to the application or the system.

Some countries have a good track record for deployment of *e*Safety. For instance, Sweden has achieved a very high field deployment for ESC by actions agreed by all national stakeholders. They have also utilised effectively the market penetration via large vehicle fleet owners. This can be seen as an example for the deployment ofSafety applications in other Member States.

It is highly recommended to have targets that are clear and simple to explain and easily understood by the consumers. Awareness campaigns for the most promising systems from the list of priority systems are important. If regulations are required for well recommended and available systems, technical definitions should be available to set clear quality levels to avoid insufficient solutions.

Crossborder applications like eCall and RTTI need a minimum of general standardization to make solutions available for all Member States while respecting the subsidiarity principle.

Smart, safe and clean mobility demands a high level of information and communication between all relevant partners. High efficiency for urban mobility can only to be achieved if traffic management centres are connected across the country and between Member States at the relevant areas. Actions like EasyWay are ideal vehicles for deploying such cooperation and data exchange.

For applications and systems not yet showing a positive business case for the stakeholders involved, the Member States might support with appropriate measures. Industry could get better conditions and /or the consumer could be triggered by incentives. Incentives could be used in some cases just to start the ramp up process for getting systems and solutions into market.Regulations are a last means but should not be applied to compensate for negative business cases. The overall focus has to be large-scale deployment instead of having just a small number of high-end vehicles equipped with the effective systems.

To summarize, the following major targets should be addressed in appropriate manner enabling to have a measurable advantage within the next few years in compliance with the European actions such as the ITS Action Plan.

- It is important to concentrate on a few but efficient systems and applications, such as the eSafety priority systems listed in this document of the core European ITS services identified by the EasyWay project.

- is The large scale deployment of active intervention driver assistance systems (or advanced driver assistance systems) to increase tvehicle safety and reduce the number of fatalities would benefit from clear system descriptions and performance criteria specifications. This would enable easier decision-making on incentives etc. for e.g. emergency brake applications and lane keeping assistance systems.

- Despite the recent regulation and mandation of ESC and LCA, the deploymentshould be driven by market demand itself to get higher deployment of eSafety related systems. Regulation is only required, if the market does not work properly.
- Systems, which support the driver very actively in different driving situations, are not to be compared with autonomous driving in general, as this is not covered by existing regulations. As long as the driver can interfere with the function or the function is only active at situations where the driver is not capable to react, the driver still remains responsible. Today's applications are following this type of rationale.
- Informative applications such as RTTI should be interoperable within the whole European area to offer a unique and efficient use of such systems. This might be a general task for the European Union Member States. On the other hand,

national regulations concerning these services have to be decided upon at the national level and under the subsidiarity of the Member States themselves, but would benefit from being similar to available regulations elsewhere in Europe. Aftermarket and nomadic solutions are especially well suitedfor informative applications and systems, and provide means to accelerate the fleet penetration of the systems very quickly. Standardised interfaces, safe vehicle installation and nomadic gateways in vehicles would be useful for the deployment of these systems.

Priority actions also include:

- eCall implementation with a minimum of standardization to make it work across Europe
- RTTI applications with cross border function
- Intelligent truck parking space management along the TERN
- Interoperability and compatibility of consumer oriented services free of charge for the minimum of information for the end user
- Continuity of services also between the urban areas and interurban areas
- Technical definitions and standards to enable interoperability as well as to enable incentives and other implementation support measures
- Develop well-working public private partnerships for the creation of business cases driven by the industry

8.4 Road operators

On public roads, the public authority concerned has normally the entire responsibility for traffic safety, efficiency, mobility and environmental issues on the network concerned. For national road authorities, which can basically be seen as an extension of the Ministry of Transport of the country concerned, the road authority has often a broader responsibility and this comprises the whole national road transport network, governmental, municipal, regional roads. When it comes to legal issues the national road authority has also some impact on the private roads.

When the responsibility is broad as with public authorities, it is recommended to focus and support implementation of validated eSafety applications and functions, where impact assessments has been done and where we know that the systems can deliver. A good example are impact studies made on ESC (Electronic Stability Control). These studies, including impact assessments, were made in co-operation between an insurance company and a public road authority followed by common dissemination activities. This altogether has given a strong effect on the penetration rate among the new cars sold.

A strong recommendation to the road operators is to cooperate with other actors in the road transports system to develop new knowledge about the impact of eSafety systems. So far, the knowledge about the traffic safety effects of the majority of vehicle-based systems has been mainly with the vehicle manufactures. This is especially valid for systems such as blind spot monitoring, automatic head light activation, adaptive head lights, and adaptive brake lights.

Speed alert and alcohol interlocks are currently the most efficient when it comes to prevent speeding and driving while intoxicated (next to legislation and effective control and driver education). On the other hand, until now the car manufacturers have not always offered these functions in new cars as optional equipment. Instead, these systems have been mainly offered as an aftermarket product with significant penetration. The transport market and especially road haulers seems to adopt speed alert and alcohol interlock as tools in their quality and education program. Speed alert has also shown to be powerful tool to save fuel cost and consequently reduce CO2 emissions. It is also well known that a big part of the fatalities happens in accidents were the driver is under the influence of alcohol. Altogether it is recommended that the introduction of alcohol interlock and speed alert systems is supported by all actors that share the responsibility for a safe and sober road transport system.
From an automotive viewpoint speed alert systems are either available as speed limiters (where customer can set a speed limit he will not overrun unintentionally) or as CC or ACC (Cruise Control, Advanced Cruise Control) with a similar effect (set of a legal speed according to traffic situation). Concerning alcolocks Swedish vehicle manufacturers were the first to experiment with such systems. There are still possibilities to by-pass the system and further works needs to be done.

When it comes to systems like lane departure warning and traffic sign recognition it is important to establish a constructive dialogue between the car manufacturers and the road operators to define the minimum standards on lane marking and traffic signs (harmonization across Europe) to ensure a good functionality of the systems. Lane departure warning (LDW) shows a higher grade of maturity and also larger benefits than traffic sign recognition. It is recommended that the road operators frequently maintain the lane markings and keep updated information about the current standard of lane markings on the network. During winter time many markings, however, can disappear or systems become temporarily unusable with strong back lighting.

RTTI is an important service to the motorists and to other road users. Methods for collection of traffic data and all other data that is used to provide RTTI services can be improved to give the customers more relevant information of high quality. New traffic data methods come with the implementation of the latest cellular telecom systems like 3G and LTE (4G). It is important that the system developers in the road transport system take advantage of the investments in the Telecom infrastructure, which is mainly done to support the connectivity between people. This infrastructure can also be used to connect vehicles with each other and vehicles with the infrastructure. Today, floating cars are using these latest communication technologies to deliver travel time data to traffic management centres, to service providers and to fleet management systems. It is recommended that all actors in the RTTI value chain intensify their work to improve the quality parameters of the traffic and travel data.

Insurance schemes, called pay-as-you-drive, enable motorists to reduce their insurance premium by driving in accordance with laws and regulations and on road networks that have a higher traffic safety standard. These insurance schemes have faced a tremendously fast development in southern part of Europe. Road operators and especially road authorities can promote the implementation of such schemes by providing the enacted legal orders for the traffic regulations in a structured way.

All actors taking part as system designers of the road transport system are recommended to support the introduction of traffic insurance based concepts such as "pay-as-you-drive". As it is a marked driven product, it is obvious through the rapidly developing penetration that the concept is based on a validated business model. The benefits of such schemes are in reduced fraud cases and automobile thefts in addition to improved traffic safety.

Concerning eCall it is recommended to support the initiatives taken by the European Commission, to follow the recommendations of the European eCall Implementation Platform (EeIP), to set up national deployment platforms and to actively promote the standardization process through national standardization authorities. The benefits with eCall are obvious and supported by a number of studies but there are mainly organisational issues that need to be solved on the Member State level.

8.5 Industry

Starting with the financial crisis, which broke out mid of 2008, the world and in particular the automotive industry was hard hit by an unparalleled economic crisis.. The crisis is still going on. While car sales dropped by 13.9% in the first five months of 2009, truck manufacturers almost lost 40% of their sales. By the end of 2009, however, passenger car sales significantly recovered due to the scrapping schemes for 8+ year-old cars in many Member States so that by December 2009 the same sales level was reached again as in 2008. For trucks, the bad situation continued with a drop of sales volume by 34% towards the end of 2009 vs. 2008. , Scrapping schemes, however, do not lead in general to a boost in sales for safety options, on the contrary.

Automobile manufactures and their suppliers also struggled hard in 2009 to keep up the R & D level for in-vehicle safety features. In times like this, additional requirements especially requesting more regulation are counterproductive. Consequently, not everybody in the industry is currently in favour of pushing ITS and ICT based systems under the ITS Action Plan & Directive or other initiatives.

The more, however, it is valid to stick to a number of principles like

- Integrated approach to road safety
- Shared societal responsibility
- Interoperable, market driven and technology neutral solutions
- Affordable for the customer and supported by positive business case
- Meeting legal requirements with regard to privacy, data protection, liability issues

According the sequence of the ITS Action Plan the industry recommends the following:

(1) Real-time and dynamic traffic and travel information (RTTI) is an essential prerequisite for any professional traffic management when based on TMC, TPEG, DAB, digital maps and on-board GPS services and need to be implemented with high priority following the recommendations of the WG-RTTI. Special focus should be on the quality and completeness of the data collection, its interoperability and expansion to co-modality. In this context it is important to

bring the different stakeholders (public and private) together under a common RTTI Deployment Platform (extension of TISA - Travel Information Service Association).

(2) Concerning the deployment of ADAS and other safety & security services it is recommended that such ITS applications follow a market demand, stay affordable and are based on a solid business case and impact analysis. Many of the ADAS applications are still under development or have just reached a very low market share (far below 1 %), so that its potential impact needs to be further researched and evaluated.

(3) This is also valid for HMI questions where the ESoP (European Statement of Principles) should only relate to information and communication devices and related applications while ADAS should initially follow an agreed Code of Practice. The revived HMI working group delivered its final report in October 2009 with some new recommendations:

- The overall conclusion is that the ESoP is essentially adequate but that a substantive update could now be undertaken (which could also include a number of identified editorial issues).
- There is also a need to monitor ongoing developments such that the ESoP can be revisited periodically (at least every three years) providing a balance between current relevance and stability.
- During discussions it was appreciated that the Personal Navigation Devices (PND) industry is maturing and leading manufacturers appreciate the importance of good HMI. A larger concern surrounds other Nomadic Devices (NDs), particularly Smart Phones and Personal Digital Assistants (PDAs), where the hardware is multi-purpose and not specifically designed for in-vehicle use but is rendered useful while driving as a result of application software.
- In discussions it became clear that verification criteria for the ESoP as a whole was not considered achievable, but in some cases might be desirable. This points to the need for further intensified research on the one hand; on the other hand this raises the issue of how the ESoP might be used beyond its initial objective of general design advice. It should be stressed that the working group recommends that solutions on the level of individual Member States or regions should be avoided.
- Separately from any ESoP development, the PND industry might develop certification procedures for NDs. However, how any verification procedures and criteria are used (e.g. selfcertification, external certification) is a matter of implementation for individual stakeholders.
- In the new consensus report, seven detailed recommendations are made concerning short-term ESoP development, eight recommendations are made concerning investigations and longer term ESoP development and five recommendations are made concerning development and application of verification criteria (see eSafetySupport website).

(4) Major progress has been achieved in the area of electronic stability control (ESC), where systems will now be mandated from 2011 onwards for M1/N1 new vehicle types. ESC systems are mature autonomous safety systems with an already average European penetrations rate for new vehicles of above 50% (some

countries higher than 90%). ESC has also be included in the new EuroNCAP evaluation scheme.

(5) Concerning speed alert, the European Commission and the other stakeholders should solve the currently open issues with infrastructure related systems and utilise the implementation roadmap produced by the SpeedAlert project. Many manufacturers are currently providing the system based on traffic sign recognition or through cooperation with Nomadic Device Manufacturers (it is expected that integrated navigation systems will also display speed information soon).Discussions and research should be initiated between road operators, public road administrations and the (digital map) industry to ensure the reliable identification of all types of permanent and temporary speed limit signs.

(6) Concerning dynamic traffic management and local danger warnings, the road authorities and operators should develop a joint European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with vehicle and telecommunications industry.

(7) Concerning eCall it is strongly recommended to finalize the standardization process before now mid of 2010 (, MSD= Minimum Set of Data, In-Band Modem specifications/transport protocols, HLAP = High Level Application Protocol currently either already approved or in the approval process) and agree on the different operational requirements as currently driven by CEN (Public eCall OR done, TPS (Third Party eCall Support Servivce) OR in finalization, Quality of Service document pending.
The recommendations from the eCall Driving Group are still valid, in principle. Even though there might be a tendency to mandate eCall as part of the ITS Action Plan & Directive the working group "Implementation Roadmap" still favours a voluntary approach and help to create a market demand for this life-saving service by making the customers aware of the benefits of eCall. Financial incentives and/or support are a valid means to support a faster ramp-up of eCall services and the necessary infrastructure.. Due to long decision processes on the public side a binding commitment to create the necessary infrastructure is required to avoid that in-vehicle systems are introduced but no infrastructure available to forward the calls. The industry recommends to intensify the efforts in the European eCall deployment platform (EeIP), to execute a stricter project management to achieve results and to encourage the establishment of national rollout platforms for direct deployment after successful testing.

(8) Also covered by the Implementation Roadmap is the setting up of cooperative systems to move into a fully connected interoperable society. The industry supports these activities as being an important pre-condition for further improvements in road safety and security but request full stakeholder involvement applying an integrated approach.
It is also strongly recommended to continue with field operational tests to prove technical functionality and impact on road safety. A feasible approach is to start with vehicle to infrastructure and vice versa communication first before vehicle to vehicle communication is deployed. Later will still take several years to mature but standards should be developed now without further delays. Key topic is on how to finance the initial infrastructure, as customers would be rather reluctant to

pre-finance something they do not have an immediate benefit from. Potential business models should be based on Public-Private Partnership arrangements and could propose a certain date when all new type-approved vehicles would offer this connectivity preferably on a voluntary basis. If this is then based on an open Telematics platform or something else should be left to the industry.

(9) As communication can also be done by other than vehicle-embedded devices, e.g. nomadic devices like next generation of PNDs, PDAs, smartphones (iPhone, Google Phone, etc.), including GPS functionality, these devices need to be included in the tests. As development and lead times in the consumer electronics area are much shorter an earlier introduction might be possible for such devices but require European-wide coordination and possibly some kind of framework regulation.

(10)

The systems investigated in the Implementation Road Map working group do not cover all technical solutions affecting the safety of road traffic. For instance, nomadic devices have not been discussed in detail in spite of their growing influence on vehicle communication. However, an eSafety working group (Nomadic Device Forum) just delivered a very comprehensive report on the business opportunities and challenges PND (Personal Naviation Devices) will be facing in the next years. See:
http://www.esafetysupport.org/en/esafety_activities/esafety_working_groups/nomadic_device_forum.htm

8. 6 Other stakeholders

The Implementation Road Map Working Group of the *e*Safety Forum has focused its work on vehicle- and infrastructure-based *e*Safety systems. New *e*Safety systems are likely to come faster into the market than in the past. For instance, the 50% market penetration of ABS in Germany took about 20 years starting in1978, whereas the same level of penetration was reached for ESC in just 10 years, starting in 1995. Based on already existing basic technologies and sensors, new functions can faster become standard equipment in new vehicles. The General Safety Regulation published by the Commission in 2008 especially requests – next to ESC – the promotion of two other ADAS applications: Lane Departure Warning and Automatic Emergency Braking Systems. Agreements on open application development platforms in vehicles can also increase the speed of *e*Safety system rollout.

The use of sensors for surrounding recognition like Radar, LIDAR (LIght Detection And Ranging), ultrasonic and video camera systems can enable warning systems (first step), enhance both active and passive safety systems (second step) and finally activate collision avoidance/mitigation actions like autonomous braking.

A combination with enhanced traffic and travel information (RTTI) based on TMC and DAB, digital maps and on-board GPS / Galileo (satellite positioning) services can lead to a comfortable and safe way of travelling. Satellite positioning based eCall systems can bring those basic technical features into the vehicles, and the sensor signals could also be shared for other use than eCall.

Technological development is on a high level, but there has to be a stronger customer demand, a higher awareness for safety functions and also a positive business case. Combining comfort functions with safety functions can lead to a high market demand.

Regulatory prerequisites exist in some cases, radio-based systems e.g. automotive radar, TPMS and others needs significant support to get the regulatory framework such as frequency allocations in place and worldwide harmonized; just some conditions for type approving complex and safety related systems are still not defined. Concerns regarding product liability still need to be addressed in some cases.

8. 7 Working Group recommendations

The working group identified, after an assessment of the safety potential and implementation status and readiness of the various *e*Safety systems, twelve priority systems for the *e*Safety deployment up to 2020.

In addition to the Implementation Road Map working group, other working groups have also investigated the implementation of *e*Safety systems. The RTTI and Heavy Duty Vehicles working groups and the eCall Driving Group have produced detailed recommendations and road maps for their respective implementations.

It is interesting to note that the list of priority systems as identified by the Implementation Road Map working group has its focus on autonomous in-vehicle systems on one hand and road infrastructure systems on the other hand. Co-operative (vehicle and infrastructure) and other networked systems, on the other side, are still mostly in the development stage. The situation is partly due to the diverging fundamental objectives of private and public stakeholders

The descriptions of the implementation issues are much more detailed for the infrastructure related systems than for autonomous vehicle-based system.
It is obvious that all solutions, which more or less need a PPP (Public-Private Partnership) arrangement between public authorities and private companies, are more complicated and also become very complex within the European context for standardisation and harmonisation. Setting up agreements between all Member States and a number of industrial consortia is time consuming and also affected by different national or single company interests. Vehicle-based systems have an advantage in this comparison; only the manufacturer and the customer have to agree on new systems (partly some homologation issues are to be solved). The exemption are radio – based systems where significant effort is needed to achieve frequency regulations in the European Members States and worldwide.

Nevertheless, in order to reduce road fatalities in Europe, infrastructure-based, vehicle-based and co-operative solutions are required. Improvements in the infrastructure affect directly each vehicle/driver, which uses the roads, whereas the effects of improvements in the vehicles depend on the fleet penetration of these improvements.

The costs for the *e*Safety systems are not always allocated to all of those getting the benefits from the systems. In many cases, the society and insurance companies are getting a positive business case in the form of reduction of accidents, fatalities and their costs while only the user/customer has to pay for the systems. When both savings and costs are put in the same equation, a positive business model could be developed leading to positive business cases for each stakeholder group.

The systems investigated in the Implementation Road Map working group do not cover all technology solutions, affecting the safety of road traffic. For instance, nomadic devices have not been discussed in detail, except as alternative solutions to vehicle-based systems. Also systems, which are already or will, according to the working group's judgement, certainly be a standard in the next generation of vehicles, such as e.g. ABS, seat belt reminders and most recently ESC, were also left out.

The recommendations for the priority systems as identified in the Implementation Road Map working group are given below:

Recommendations for in-vehicle systems:

a. The automobile industry, European Commission, the Member States and other stakeholders should enhance the customer awareness of the safety benefits of such systems in vehicles through well-structured and harmonized European campaigns. The awareness (and involvement) regarding eSafety systems among the personnel involved in the sales of new passenger cars should be dramatically increased. This could be achieved by a European wide educational effort organised by the OEMs and the device suppliers.

b. The Member States and insurance companies should give financial/fiscal incentives to customers to buy vehicles equipped with effective systems fulfilling the detailed specifications and standards drawn up for such specific systems. For this purpose, the discussion should start without further delay to clarify the possibility for incentives given by insurance companies or governmental authorities to follow the example of tax incentives for lower emission vehicles..

c. The EC and the Member States should support frequency allocations for radio-based systems. Earlier automotive applications used ISM bands (ISM – Scientific Industrial Medical). Meanwhile these bands are overcrowded, their usability for applications of automotive safety is limited. In addition higher bandwidth is required e.g. for automotive radar to achieve higher local resolution. Some sensor applications use also Ultra-Wide Band technology. Frequency allocation means frequency sharing with primary or secondary services and is very complex, time consuming and leading to restrictions. Support is needed to achieve viable frequency allocations especially for applications with high benefit for road safety. This includes also the possible support in the worldwide harmonization of the frequency allocations.

d. The European Commission should initiate actions to make information on the availability and actual integration of eSafety systems in a vehicle public. The data collected by these systems should be used for accident research and vehicle inspection purposes across Europe provided the justified interests of affected stakeholders do not stand against such usage. While OEMs know exactly which safety option the customer has selected, this information is not generally available. It needs to be discussed between the different stakeholders how such information can be made available to improve the eSafety system impact database and how such system affect road safety.

e. The European Commission, together with the Member States, industry and all other stakeholders, should continue promoting R&D to improve existing safety and develop new improved safety systems. Research should also continue on co-operative (vehicle and infrastructure) systems, especially on applications dedicated to safety and energy efficiency. Improvements on existing systems through the addition of V2V and V2I functionality should also be considered.

f. All stakeholders should develop feasible sustainable business models for each application on the principle that those who benefit from the introduction in the form of reduced accident-related costs should share these benefits with those who have to carry the investments and costs. This should also cover nomadic and aftermarket device based solutions

g. Steps towards deployment should be supported by the European Commission through Field Operational Tests (FOT's) and CIP pilots considering appropriate and feasible sustainable business models for each application. In specific cases, it may be necessary to establish PPP's (Public-Private Partnership) arrangements between public authorities and private companies.

h. The role nomadic devices can play for speeding up the deployment of safety applications and related services need to be further elaborated. The eSafety Nomadic Device Form has an important role to play to bring together the different stakeholders.

<u>Recommendations for autonomous vehicle systems:</u>

In order to increase and accelerate the market penetration of *e*Safety systems with highest safety benefits, such as and going beyond ESC,

i. EuroNCAP should incorporate such systems into their rating as soon as proven technology and safety benefit data becomes available, and the functionality of the systems can be adequately tested.

j. The European Commission and the Member States should consider regulatory actions (such as making a system mandatory equipment in new vehicles as already decided for ESC and Tyre Pressure Monitoring) only as a last option, when such action is judged as essential and beneficial for both industrial and public stakeholders and when the related technologies have proven their maturity. Socio-economic reasons and respecting the principle of subsidiarity are other important decision criteria. Voluntary solutions should be favoured.

k. The Member States and the industry should comply with the new European Statement of Principles (ESoP) for HMI (Human Machine Interaction) for safe integration of devices into the vehicles and the recommendations of the HMI Working Group to ensure future user acceptance and a safe application and function of the systems during their whole life cycle

l. The automobile industry, European Commission, the Member States and other stakeholders should continue and support R&D efforts to develop new technologies and solutions for in-vehicle safety systems as well as to evaluate the effects of *e*Safety system on safety, mobility, environment, economy and employment.

<u>Recommendations for infrastructure-related systems:</u>

In order to increase and accelerate the deployment of safety beneficial infrastructure-related *e*Safety systems,

m. The Member States should ensure the deployment of socio-economically feasible systems and services according to their responsibility and in line with the requirements accepted on the European level.

n. Improvements in the infrastructure are required to implement a number of infrastructure-based and co-operative solutions. Although those improvements depend essentially from the Member States, the European Commission should develop all the necessary steps to support them, through the instruments at their disposal (e.g. ITS Action Plan, EASYWAY project, TEN-T programme) and using new methodologies like Lead Markets (increase the willingness of countries and regions to take on the role as "early adopters" for eSafety systems) and Pre-Commercial Public Procurement.

o. The industry, European Commission and the Member States should together take actions to ensure that digital maps with the information required by the *e*Safety systems would be developed for all roads in the Member States

p. The actual systems will in the future be object of further integration and improvements towards an increasingly automated driving. Safety will be increased, fuel consumption will be reduced and the overall capacity of the transport system will be increased. However, the European Commission should assess a number of issues that need to be addressed:
• Standardization of communication channels, protocols and services across Europe;
• Standardized equipment of intelligent road infrastructure across Europe;
• Same level of quality of services all over Europe;
• Safety responsibility/liability with respect to the interpretation of the

Vienna Convention; and
• Business cases needs to be developed and made attractive for all involved parties.

q. The European Commission and the Member States should continue to support R&D efforts to develop new technologies and solutions for infrastructure-related safety systems as well as to evaluate the effects of such systems on safety, mobility, environment and other socio-economic factors

Concerning eCall,

r. The European Commission, the Member States, the industry and other stakeholders should support the European and national implementation platforms to ensure the deployment of eCall across Europe
s. The European Commission should actively follow the standardisation activities in CEN and ETSI to ensure the timely delivery of standards and operating requirements

Concerning RTTI,

t. The European Commission, the Member States and the industry should follow the recommendations of the RTTI Working Group

Concerning dynamic traffic management and local danger warnings,

u. The road authorities and operators should develop together a European vision and strategy for the deployment and operation of dynamic traffic management and local danger warning systems in co-operation with vehicle and telecommunications industry.

Concerning speed alert,

v. Concerning speed alert, the European Commission and the other stakeholders should solve the currently open issues and utilise the implementation roadmap produced by the SpeedAlert project.

ANNEX 1: LITERATURE REVIEW ON SAFETY EFFECTS OF PRIORITY SYSTEMS

Priority *e*Safety systems and safety

The following gives a summary of the research results on the safety impacts of the priority systems as recommended by the Implementation Road Map Working Group.

Electronic Stability Programme

A study of accidents in Sweden shows that there are positive effects of ESC (Electronic Stability Control) overall and in circumstances where the road has low friction. The overall effectiveness on all injury crashes except for rear end crashes was 16.7 +/- 9.3 %, while for serious and fatal crashes the effectiveness was 21.6 +/- 12.8%. The effectiveness for serious and fatal crashes on wet roads was 56.2 +/- 23.5 %. On roads covered with ice and snow, the corresponding effectiveness was 49.2 +/- 30.2 %. The estimates are based on the assumption that rear end crashes on dry road surfaces are not affected at all by ESC. (Lie et al 2005)

A study by DaimlerChrysler investigated the impacts of ESC with the help of German accident statistics. ESC was made available for Mercedes-Benz passenger cars starting in 1995. Between 1997 and 1999 the equipment level of Mercedes-Benz passenger cars with ESC increased rapidly up to 100%. The over-all-penetration of ESC for firstly registered passenger cars in Germany was 20% in 1999 compared to 100% for Mercedes-Benz (MB). The percentage of "loss of control accidents" decreased by about 30% for MB vehicles (accident years 2000/2001) whereas the percentage of the other vehicles is decreasing at a lower rate. Only about 10 percent of all accidents with MB cars were loss of control accidents, for the competitors the rate remained at a level of about 15 percent, which was also the level for MB before ESC became standard in all vehicles. The accident rate (accidents per newly registered vehicles) decreased by about 15% for Mercedes-Benz passenger cars, compared to a drop of 11% for the competitors. The percentage of accidents outside urban roads decreased for MB vehicles from about 35 % for model year 1996 down to about 30% for model years 2000 and 2001. No significant reduction was identified for the competitors. The percentage of accidents on icy roads dropped from about 5% for model years 1996 down to 2% for model year 2001. The reduction for the competitors is much lower. The percentage of fatal and injury crashes for MB dropped from about 13% for model year 1996 down to 11% for model years 1999 and 2000. No significant reduction was found for the competitors. (Breuer 2003)

A study from United States (Dang 2004) analysed crash data from 1997-2003 from 5 US-states by comparing specific make/models of passenger cars and SUVs with ESC (Electronic Stability Control) as standard equipment versus earlier versions of the same make/models, using multi-vehicle crash involvements as a control group. The study found that single vehicle crashes were reduced by 35 % in passenger cars and by 67 % in SUV crashes. The study also showed significant or borderline-significant reductions in the multi-vehicle crash rates per 100,000 vehicle years with ESC. As multi-vehicle crashes we used as the control group and it is possible that multi-vehicle crashes are being reduced by ESC, this actually means that the true effectiveness of ESC could even be higher than we estimated for single vehicle crashes. (Dang 2004)

Another U.S. study (Farmer 2004) compared crash involvement rates for otherwise identical vehicle models with and without ESC systems. ESC was found to affect single-vehicle crashes to a greater extent than multiple-vehicle crashes, and crashes with fatal injuries to a greater extent than less severe crashes. Based on all police-reported crashes in 7 states over 2 years, ESC reduced single-vehicle crash involvement risk by approximately 41 % and single-vehicle injury crash involvement risk by 41 %. This translates to an estimated 7 % reduction in overall crash involvement risk and a 9 % reduction in overall injury crash involvement risk. Based on all fatal crashes in the United States over 3 years, ESC was found to have reduced single-vehicle fatal crash involvement risk by 56 percent. This translates to an estimated 34 percent reduction in overall fatal crash involvement risk. (Farmer 2004)

A recent German overview (Langwieder 2005) has summarised all available scientific studies on the impacts of ESC. The overview states that independently of the examination methods and the selection criteria in the different international studies, all studies resulted in quite similar estimates of ESC efficiency. In Germany, 100 per cent equipment of all cars with ESC is estimated to reduce the number of accidents with car occupant injuries by about 7 -11 %. The reduction in the car occupant fatalities would be approximately 15 -20 % (Langwieder 2005).

A study made in UK (Frampton & Thomas 2006) was based on the national accident statistics of Great Britain. The crash experience of 10475 cars was analysed and compared to a closely matching set of 41656 non-ESC cars using case-control methods. Overall the cars with ESC were involved in 7% fewer crashes although the effectiveness is substantially higher under conditions of adverse road friction i.e. 20% reduction on snowy and icy roads. ESC equipped cars are involved in 25% fewer fatal crashes and in 11 % fewer serious crashes.

A study undertaken by the University of Cologne analyses that 4 000 lives could be saved each year and 100 000 injuries could be avoided each year on European roads if all cars would be equipped with ESC. The ESC analysis shows that for every Euro invested in ESC cost savings of 3.5 – 5.8 Euro arise to society. (Baum et.al., 2007)

Erke (2008) summed up the evidence from empirical studies on the effects of ESC on accidents in a meta-analysis. The study concludes on a 49% reduction in single vehicle accidents, 13% reduction head-on collisions and 32% reduction of multi-vehicle fatal accidents due to ESC improving driving dynamics and reducing the probability of loss of control. However, a sensitivity analysis indicates results for single vehicle accidents likely to be affected by publication bias. The results for single vehicle accidents are in excess of what might be expected based on studies that have estimated the total amount of accidents that may be affected by ESC. Consequently, the proportions of accidents that can be avoided by ESC is assumed to be somewhat smaller than suggested by most empirical studies. Properties of the vehicles, time trends, and driver behaviour may have contributed to the large empirical effects. (Erke 2008)

The eIMPACT project (Wilmink et al., 2008) studied the impacts of ESC in EU25 based on actual accident statistics of these countries and considering all empirical evidence compiled so far. eIMPACT indicated that the system would reduce fatalities in EU most likely by 16.6% and injuries by 6.6%. (Wilmink et al., 2008)

Some recent studies indicate that ESC also involves behavioural adaptation. Rudin-Brown et al. (2009) shows that 90% of Canadian drivers who knew that their vehicle was equipped with ESC believed that ESC had made it safer to drive and reported being confident that ESC would work in an emergency. 23% of ESC owners who knew their vehicle had ESC reported noticing long-lasting changes in their driving behaviour. Hence, behavioural adaptation to ESC is likely in certain drivers; however, its proven effectiveness in reducing the likelihood of being involved in a serious crash probably outweighs any potential increases in unsafe driving. (Rudin-Brown et al. 2009)

Vadeby et al. (2009) report that about 90% of Swedish car drivers with ESC know that the car is equipped with the system. On snowy and icy roads, the drivers consistently state that they are more likely to take a risk when they think they have ABS and ESC, than when they do not have it.

Obstacle & collision warning

Concerning obstacle warning systems, simulator studies indicate safety benefits (Yamada, 2002). Hoetink A. (2003)

Collision warnings systems are currently being developed as part of or complement to Adaptive Cruise Control (ACC) system. Also a system predicting driver's braking beforehand has been found as having safety potential as a collision warning system (Sakabe et al 2002). In a study compiling information from ACC systems it was found that the possibilities of current ACC systems in improving traffic safety and reducing congestion seem limited: although positive effects on driver safety and traffic safety were found, some negative effects are a cause for concern. Improving ACC systems with a Stop-and-Go functionality, and preferably also with collision warning or even collision avoidance capabilities, might improve traffic safety and at the same time reduce congestion (Hoetink 2003).

Wakasugi and Yamada (2000) show that with a Forward Vehicle Collision Warning System (FVCWS) the average reaction time from the warning output to braking is 0.73 s and 95% of the drivers can react in 1.0 s or less. The results indicate that the warning system compensates for a decline in driver perceptual ability caused by sleepiness.

Jamson et al. (2008) showed that both unadaptive and adaptive forward collising warning (FCW) systems benefited driver safety in rural conditions. When the system was functional, brake reaction time was reduced and during the braking events, drivers remained further from a collision with a lead vehicle. Neither sensation seeking nor an individual driver's brake reaction time affected the speed of their response to the traffic events. Benefits of the adaptive system were demonstrated for aggressive drivers (high sensation seeking, short followers). The aggressive drivers rated each FCW more poorly than their non-aggressive contemporaries. However, this group, with their greater risk of involvement in rear-end collisions, reported a preference for the adaptive system as they found it less irritating and stress-inducing. (Jamson et al. 2009)

Schittenhelm (2009) estimated that a normal driver is able to avoid a collision with a vehicle in front in 20 percent of all cases and to reduce the severity in an additional 25 percent thanks to DISTRONIC PLUS (ACC, collision warning) and BAS PLUS (emergency braking support). A normal driver is able to avoid or mitigate each second collision with a vehicle in front respectively each fourth with a vehicle behind thanks to the DRISTONIC PLUS (ACC, collision warning, emergency braking support) package.

The eIMPACT project (Wilmink et al., 2008) studied the impacts of ACC in its Full Speed Range (FSR) version for EU25 based on actual accident statistics of these countries and considering all empirical evidence compiled so far. The system is effective but addresses only a very small part of the accidents. eIMPACT indicated that ACC-FSR would reduce fatalities in EU most likely by 1.4% and injuries by 3.9%. (Wilmink et al., 2008)

Emergency Braking

Direct empirical evidence on safety impacts does not exist for Emergency Braking, which has not been introduced before 2006. Some papers address Emergency Brake Assist, which can be used for analogies to Emergency Braking.

The introduction of automatic emergency braking changes the distribution of impact severity thus the resulting injury risk. Krafft et al. (2009) found that such braking can offer major benefits. A reduction of speed before impact with 10 % can reduce fatal injuries in car crashes with approximately 30 %.

Page, Bruno and Cuny (2005) studied the expected and observed effectiveness of the Emergency Brake Assist (EBA) in terms of reduction in injury accidents in France. The evaluation of the expected effectiveness of EBA is based on the simulation of the reduction in injuries in non-EBA cars which could result in lower collision speeds resulting themselves in higher mean deceleration, would EBA have been available and applied in those cars. A sample of fatal police reports was used for the simulation. The observed effectiveness was estimated on the basis of accident statistics. The expected effectiveness was a reductions of 7.5% in car occupant fatalities and 10% reduction in pedestrian fatalities and the observed effectiveness a 11% reduction of injuries. (Page, Bruno & Cuny 2005)

Daimler have carried out research in driving simulators to assess the effects of brake assist plus. This research involved 100 ordinary drivers driving around simulated highways and secondary roads and being presented with a range of critical situations such as approaching the end of a highway traffic jam at high speed and a vehicle ahead suddenly braking. In a vehicle with conventional brakes 44 percent of all drivers suffered a collisions but with brake assist plus fitted this was reduced to 11 percent, suggesting a substantial benefit for front to rear end collisions between cars. (Kulmala et al., 2008)

Schittenhelm (2008) estimated that emergency braking support combined to a collision warning system would reduce rear-end crashes by 20% and in addition, reduce the severity of rear-end crashes by 25%. The rear-end crash avoidance potential is estimated to be 37% on motorways. Schittenhelm (2009) estimated that a normal driver is able to avoid a collision with a vehicle in front in 8 percent of all cases thanks to Brake Assist (classic). A normal driver is able to avoid or mitigate each second collision with a vehicle in front respectively each fourth with a vehicle behind thanks to the DRISTONIC PLUS (ACC, collision warning, brake assist, emergency braking, parking support) package.

The German Insurers Accident Research (Kuehn et al., 2009) stated that a Collision Mitigation Braking System (CMBS), which is able to gather information from the environment, to warn the driver and to perform a partial braking manoeuvre autonomously (CMBS 2), could prevent up to 18 % of all car accidents with personal injuries in the data sample. CMBS3 including autonomous full braking could prevent 41% of all accidents involving cars.

The eIMPACT project (Wilmink et al., 2008) studied the impacts of Emergency Braking in EU25 based on actual accident statistics of these countries and considering all impact evidence compiled so far. eIMPACT indicated that Emergency braking would reduce fatalities in EU most likely by 7% and injuries by 7.3%. (Wilmink et al., 2008)

Blind spot monitoring

Due to the early stage of deployment no scientific evaluation for blind spot monitoring systems is available, but given by accident situation analysis (see Annex) lane changing accidents are calculated with about 3.500 fatalities /major injuries each year. Such systems are since 2004 available on several new vehicles. It has to be monitored what deployment rate will occur.

Adaptive headlights

Rumar (1997) has studied the feasibility of a unified, adaptive vehicle illumination system, including direct and indirect illumination systems, systems for adverse weather and street lighting conditions and daytime running lights. The extent of road safety impact of such a system will rely on how drivers will adapt their behaviour to the increased visibility conditions. Drivers have been found to compensate for the improved vision by increasing their speeds as demonstrated, for example, by Kallberg (1991).

Lane Departure Warning

According to Abele et al (2004), lane departure warning systems can prevent or reduce the severity of the accidents in which two vehicles collide frontally (head-on collision), accidents in which a vehicle leaves the road without colliding with another vehicle ("left roadway" accidents), and accidents in which two or more vehicles collide laterally (side-collision accidents. Abele et al (2004) concluded the following estimates of the impacts of lane departure warning systems:

- Head-on collisions: lane departure warning enables a driver to react, on average, 0.5 seconds earlier than he or she would without the system. This effects a collision reduction of 25 % for all relevant accidents. Furthermore, in 25 % of the accidents, a reduction in accident severity can be assumed.
- "Left roadway" accidents: Time gains of 0.5 seconds can also be assumed for this type of accident using a lane departure warning system. This translates into 25 % accident avoidance and 15 % accident severity reduction.
- Side-collision accidents: It is assumed that the aggregate time gain is composed of 0.5 s for the warning phase (lane departure warning and lane change assistant affect different accident causes and therefore the time gains are not combined) and 0.2 s for the assistance phase (lane change assistant with haptic feedback). The cumulated time gain is 0.7 s. This leads us to an expected 60 % reduction in the number of accidents and a 10 % reduction in accident severity.

A U.S. study (Pomerleau et al., 1999) utilised driver experiments followed by simulation of the lane keeping ability of real drivers, and provided estimates of crash potential with and without LDWS on several types of run-off road crash scenarios. The results of the study suggested that lane departure warning systems have the potential to reduce road departure crashes in passenger vehicles by approximately 10%, and reduce road departure crashes in heavy trucks by approximately 30%. The impacts on heavy trucks were relatively higher than those for passenger cars primarily because trucks have a higher frequency of drowsy related crashes and lower frequency of intoxication related crashes compared to passenger vehicles. (Pomerleau et al., 1999)

A Dutch study on the impact of lane departure warning systems installed in heavy goods vehicles concluded that the system would decrease the number of accidents involving heavy goods vehicles by 10% (Korse 2003).

The eIMPACT project (Wilmink et al., 2008) studied the impacts of lane keeping support in EU25 based on actual accident statistics of these countries and considering all empirical evidence compiled so far. eIMPACT indicated that the lane keeping support system would reduce fatalities in EU most likely by 15.2% and injuries by 8.9%. (Wilmink et al., 2008) Lane departure warning will be considerably less effective than lane keeping support.

Kuehn et al. (2009) estimated the theoretical safety potential of a Lateral Guidance System, consisting of Lane Change Assist and Lane Keeping Assist, to be up to 7 % on the basis of accident data analysis,

Real-time traffic information

Real-time traffic information about problems and hazards on the road network to drivers before the trip and during the trip to in-vehicle receivers enable the drivers either to avoid the problem by e.g. changing their route or to be better prepared for the problem by increasing their awareness and alertness. Real-time information on slipperiness and other road weather related problems has been estimated to reduce the risk of injury accidents in adverse conditions by 8 % on main roads and 5 % on minor roads in Nordic conditions (Rämä et al 2003).

Several studies have been carried out on the RDS-TMC (Radio Data System – Traffic Message Channel) service providing event information to drivers with specific RDS-TMC receivers. While there exists little explicit evidence of safety impacts, studies indicate that the service is affecting driver behaviour in the assumed direction. A study in UK showed that 45 % of drivers with an RDS-TMC receiver had changed route due to on-trip RDS-TMC messages at least once. On the basis of information received before the trip, 23 % of the drivers had changed their plans (Tarry & Pyne 2003).

Dynamic traffic management and local danger warnings

Incident warnings are provided by roadside VMS or beacons, and via radio and cellular information services. Studies usually show accident reductions on the IWS (Incident Warning System) equipped motor way sections. The whole range of the effect on the total number of injury accidents is from –35 per cent to + 9 per cent, where the largest reductions may include bias caused by the regression-to-the-mean effect. The effects are more beneficial on secondary accidents (Kulmala, Fránzen & Dryselius, 1995). According to Elvik et al. (1997), rear-end injury accidents have decreased as a result of queue warning systems on motorways whereas the number of rear-end accidents resulting in property damage only have increased. Japanese field tests (Makino 2004) of a local obstacle and congestion warning VMS system on a motorway indicated a 45% reduction in accidents after the VMS was installed, but the effect is probably biased due to the regression-to-the-mean effect.

Safety can be improved not only by just reacting swiftly to incidents but also by preventing them through harmonisation of the traffic flow. This can be accomplished by ramp control (or ramp metering), lane control, route diversion schemes, and in general traffic management. Safety is also expected to be improved as a result of replacement of manual toll collection with automatic tolling on motorways due to the elimination of traffic channelling at toll plazas as well as of the possible queues and unnecessary stops (Bandmann & Finsterer, 1997).

Lane control has little effect on injury accidents (Perrett & Stevens, 1996 and Elvik et al., 1997). Ramp control is considerably more beneficial to safety, the accident reduction on equipped motorways being up to 10 % as such, and more than 15 % as a part of an integrated motorway management system (Federal Highway Administration, 1997a; Perrett & Stevens, 1996).

Route diversion schemes are beneficial to safety only when the diversion does not increase exposure (driving distance) too much and does not divert traffic to roads with higher accident risk. Unfortunately, this is very seldom the case. The opposite case is shown by for example Lashermes and Zerguini (1997).

Route information and management systems employing VMS in Germany decreased the risk of road accidents by 15% and the risk of severe injury accidents by somewhat more, between 9 and 36 %. The impacts of the system depend on the quality of the traffic management system and the level of traffic volumes. On roads with high traffic volumes, the numbers of accidents were 22 – 64 % lower than before the implementation of the system. On roads with low or moderate volumes, the changes in accident numbers were statistically insignificant. (Siegener et al 2000)

Influencing vehicle speeds with the help of variable speed limits has been tried especially in connection with weather-related traffic management systems by lowering speed limits in adverse conditions. A variable speed limit system integrated with a fog warning system reduced the number of injury accidents on a German motorway by around 20 % (Balz & Zhu, 1994), and a variable speed limit system integrated with a slippery road warning system on a Finnish motorway by around 10 % (Rämä, 2001). Both studies reported significant reductions in mean speeds (3 to 9 km/h) in adverse weather conditions, and the latter also a significant decrease in speed variation. An accident study showed that weather-related speed control reduced injury accidents by 13 % in winter and 2 % in summer on sections, where the control system was automatic and of good quality. Manually operated systems, however, were estimated to result in increased accident risks (Rämä & Schirokoff 2004).

A Dutch fog warning system including a text warning ("fog") and dynamic speed limit VMS signs on a motorway, reduced speeds in fog by 8 to 10 km/h, although in extremely dense fog, the system had an adverse effect on speed. This was due to the too high "lowest possible speed limit" display in the VMS (60 km/h). A more uniform speed behaviour was obtained due to the introduction of the system (Hogema, van der Horst & van Nifterick, 1996). Variable speed limits have also been applied by schools, resulting in a 20 per cent accident reduction (Elvik et al., 1997).

In addition to speed control, the high accident risks caused by adverse weather conditions can be decreased by providing information, warnings and support to road users, but also by combating weather problems with the help of winter maintenance. A Finnish study (Rämä et al., 1996) showed that slippery road warning VMS decreased mean speeds by around 1–2 km/h when the signs were lit. The system was also shown to affect the direction of attention to find cues showing potential hazards, and to make passing behaviour more careful indicating an even larger positive impact on safety than that due to lower speeds (Luoma, Rämä, Penttinen & Harjula, 1997).

The automatic fog-warning system on the M25 motorway in England displays the "Fog" legend on roadside matrix signals. The assessment of this system showed that the net mean vehicle speed reduction was around 3 km/h, when the signals were switched on as a result of the formation of fog (Cooper & Sawyer, 1993). Collision warning systems are probably beneficial to road safety in the fog (Saroldi, Bertolino & Sidoti, 1997).

Extended environmental information (extended FCD)

The safety benefits from extended environmental information follow from the user services utilising the information collected. These effects are described in more detail under real-time traffic information, dynamic traffic management and local danger warnings.

eCall

Considering the safety benefits the eCall system leads to a higher efficiency of the rescue chain. When medical care for critically (and severely) injured people is available at an earlier time after the accident, the death rate can be significantly lowered. This is known as the Golden Hour Principle of accident medicine. It expresses that in general, the earlier the medical help can reach the injured, the higher is the likelihood to avoid fatalities and long-term or permanent disability. One hour after the accident, the death rate of people with heart or respiratory failure or massive bleeding approaches 100 %. This is why the rapid reaction of rescue services is very important. (Abele et al 2004)

Between 2001 and 2003, the E-Merge project approached the issue of decreasing rescue times and resulting safety benefits based on surveys conducted in different Western European countries. According to E-Merge and the *e*Safety Forum's eCall Driving Group, 5 % to 15 % of road fatalities can be reduced to severe injuries and 10 % to 15 % of severe injuries can be reduced to slight injuries. For slight injuries, no positive effect of eCall was foreseen. (E-Merge 2004, *e*Safety 2004, Abele et al 2004). In Sweden, the full implementation of eCall has been estimated to reduce the number of road accident fatalities by 2-4 % and the number of severely injured by 3-5% (Lind et al 2003).

The eIMPACT project (Wilmink et al., 2008) studied the impacts of eCall in EU25 based on actual accident statistics of these countries and considering all impact evidence compiled so far. eIMPACT indicated that eCall would reduce fatalities in EU most likely by 5.8% and severe injuries by ca. 6% whereas the number of slightly injured will increase by a small percentage due to fatal and severe injuries transformed to slight injuries. (Wilmink et al., 2008; Kulmala & Sihvola 2008)

Speed Alert

The largest study so far on Intelligent Speed Adaptation (ISA) systems have been carried out in Sweden (Biding & Lind 2002). These studies involved 5000 equipped vehicles driven by over 10000 drivers (from different age groups) in urban areas as well as an accident study. Speed alert was one of the systems studied. The studies found out that all ISA systems result in better road safety without increasing travel time, and that there were quite minor differences between the impacts of speed alert and those of other types of ISA. The estimate was that if everyone had ISA, there could be 20% fewer road injuries in urban areas.

Speed alert systems signalling with light and sound if the driver exceeds the speed limit are expected to reduce the number of injury accidents by ca. 10% and fatalities by ca. 18%. A voluntary system, where the driver can enable or disable control by the vehicle of the maximum speed has been estimated to affect safety in a similar fashion (Carsten & Fowkes 2000). Várhelyi (1997) has estimated that automatic speed limiting on rural roads would reduce the total number of injury accidents in Sweden by about 10%.

Speed alert and ISA can also be implemented as a dynamic version, where in addition to fixed speed limits the system applies temporary limitations to maximum speed due to congestion, fog, slippery road surfaces, major incidents, outside schools at drop-off or pick-up times, etc. Dynamic ISA in conditions of low friction would decrease the total number of injury accidents by ca. 12% and ISA in darkness by 12% (Várhelyi 1997). Carsten and Fowkes (2000) estimate that the dynamic version of the compulsory ISA reduces injury accidents by 36% and fatal accidents by 59%.

The eIMPACT analyses (Wilmink et al, 2008) concerned a system with visual and haptic (active accelerator pedal) taking into account fixed and variable speed limits. The impacts of Speed alert were studied in EU25 based on actual accident statistics of these countries and considering all impact evidence compiled so far. eIMPACT indicated that Speed alert would reduce fatalities in EU most likely by 8.7% and injuries by 6.2%. (Wilmink et al., 2008)

Dynamic navigation

The most recent empirical study so far on navigation has been carried out in the Netherlands (Vonk et al., 2007). The study analysed a database of damages of a car lease company, the behaviour of drivers, user reactions and existing literature. The study indicated a 16% reduction in kilometres travelled when driving to a destination in an unfamiliar area. The drivers used, on average, 2 km/h higher speeds when using a navigations system, also yielding a higher percentage of time above the speed limit (17% with the system, 12% without). When driving to a destination in an unfamiliar area, the occurrence of inappropriate behaviour was reduced (0.56/run with the system, 1.3/run without). Drivers indicated that they are more alert and have less stress when driving and using a navigation system. The claimed damage costs of lease car drivers without the system were estimated to be 5% higher than those of lease car drivers with the system.

The large U.S. Travtek field study (Imnan & Peters 1996) of navigation systems found that under normal conditions, traffic safety was not reduced. Oei (2002) noted that kilometres travelled may be reduced by 5-7% due to navigation systems. On the other hand, if reduced kilometres are resulting from more travel on lower-class roads, the average accident rate per kilometre travelled is increased for the user compensating for the reduced amount of travelling.

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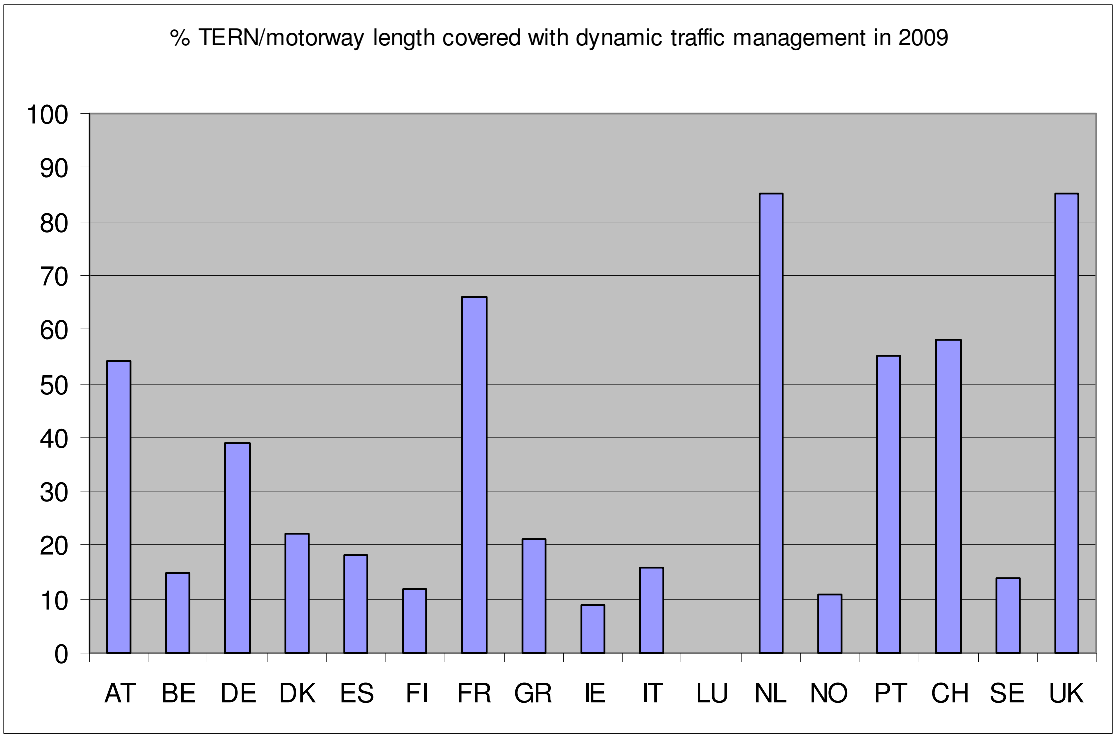
ANNEX 2: DEPLOYMENT OF ITS ON THE TERN IN MEMBER STATES


% TERN/motorway length covered with dynamic traffic management in 2009
100
90
80
70
60
50
40
30
20
10
0
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BE
DE
DK
ES
FI
FR
GR
IE
IT
LU
NL
NO
PT
CH
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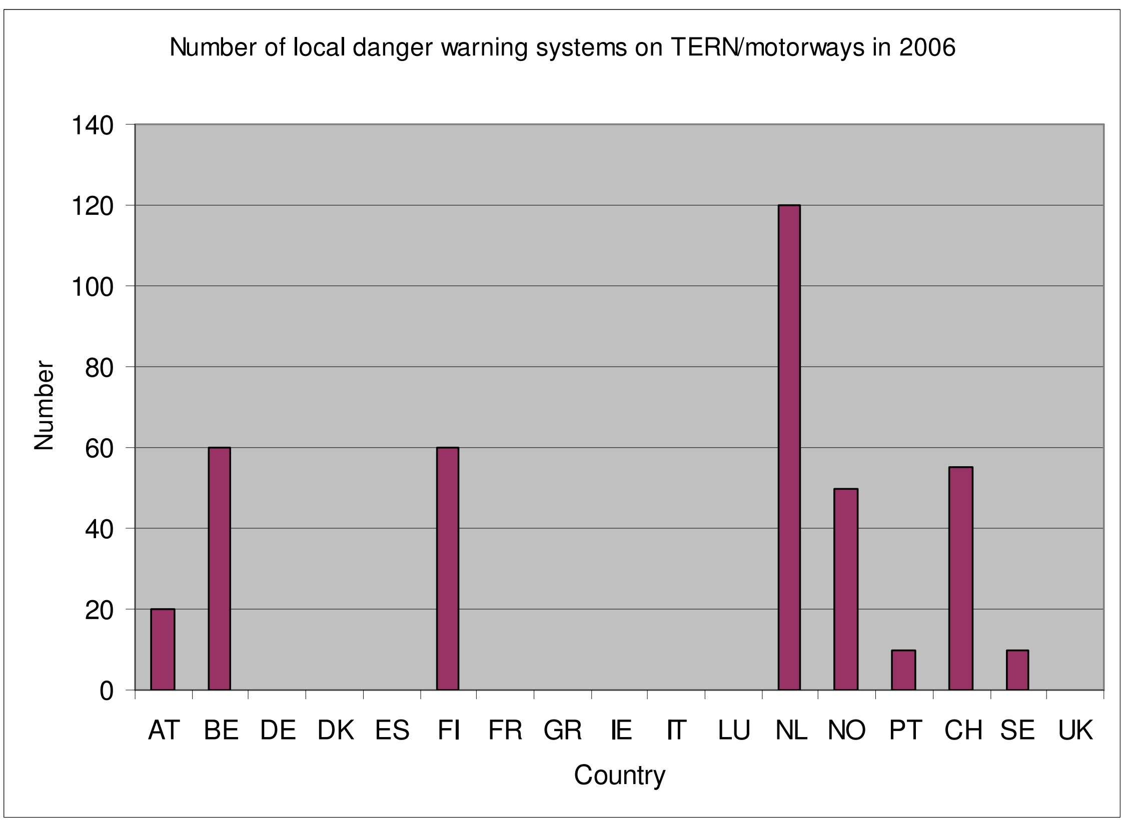
Number of local danger warning systems on TERN/motorways in 2006
140
120
100
80
60
40
20
0
Number
AT
BE
DE
DK
ES
FI
FR
GR
IE
IT
LU
NL
NO
PT
CH
SE
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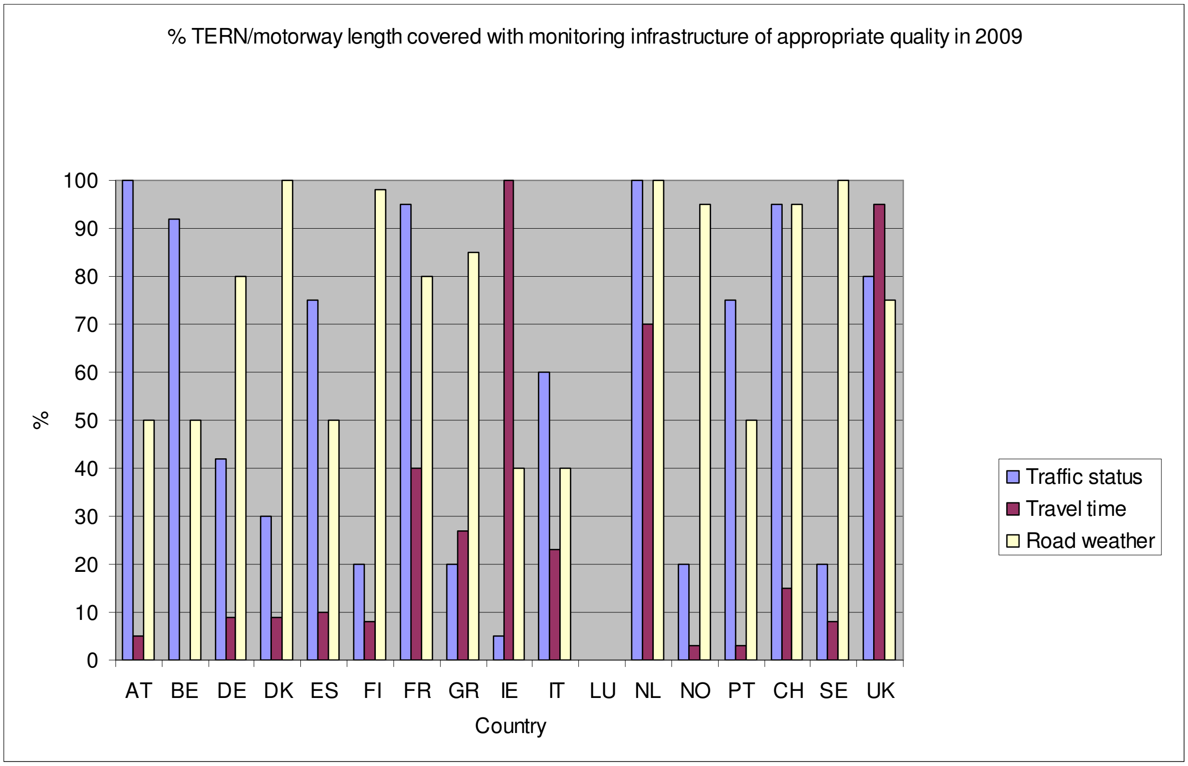
Country


% TERN/motorway length covered with monitoring infrastructure of appropriate quality in 2009
%
0
10
20
30
40
50
60
70
80
90
100
AT BE DE DK ES FI FR GR IE IT LU NL NO PT CH SE UK
Country
Traffic status
Travel time
Road weather

ANNEX 3: DESCRIPTIONS OF IMPLEMENTATION ISSUES FOR THE PRIORITY SYSTEMS

Implementation Issues for ESC (Electronic Stability Control)

A System description

ESC stabilises the vehicle and prevent skidding under all driving conditions and driving situation within the physical limits by active brake intervention on one ore more wheels and by intelligent engine torque management.

As soon as ESC identifies a critical driving situation it intervenes by applying specific brake pressure to one or more wheels, as required. If necessary, the engine torque is also adjusted automatically. In this way, ESC helps the driver stabilise the vehicle – although the extent to which it can do so is of course limited by the physical laws governing the dynamic behaviour of the vehicle.

A yaw-rate sensor and a lateral acceleration sensor continuously monitor the movement of the vehicle about its vertical axis and compare the actual value with the target value calculated on the basis of the driver's steering input and the vehicle speed. The moment the car deviates from this ideal line, ESC intervenes to counteract any incipient tendency to skid by applying a precisely metered braking force to one or more wheels. ESC systems combine the functions of ABS and TCS traction control and complement them with directional stability assistance.

B Technology Availability

ESC is in serial production since 10 years. During this time the cost have been reduced from 100% in 1995 to less than 25 % in 2005.
ESC is based on ABS, which is standard in 15 EU Countries thanks to the ACEA self-commitment. That's why the additional cost on TOP of ABS are relatively low ((ABS plus Yaw Rate Sensor with lateral acceleration Sensor, Steering Angle Sensor (Standard in vehicles with Electronic Powered Steering EPS,), Pressure Sensor, enhanced ECU and enhanced hydraulic Unit)).

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

none

F Security

G Business Case / Customer Awareness and Acceptance

Market research result - End Customer Safety Study – (more than 5000 respondents (CATI)) See attachment Customer Awareness

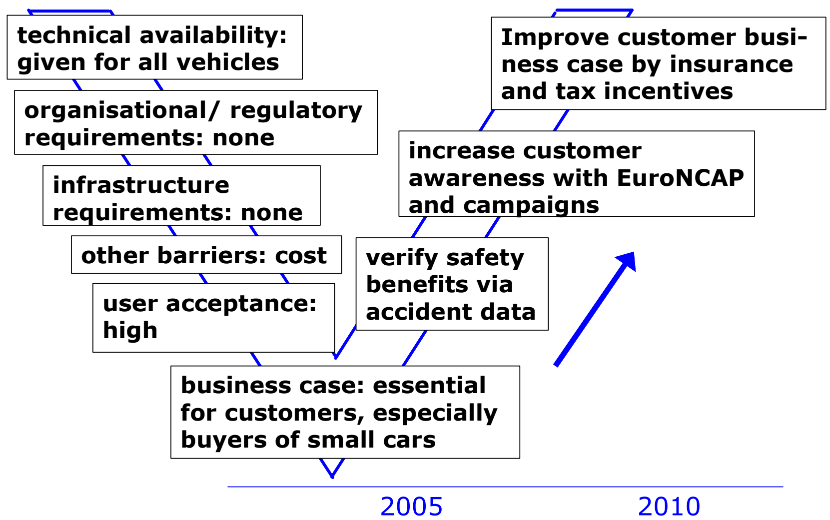
Market Research Result out of Focus-Group discussion with End Customer: New car buyers expect full safety standard in all available models.

H Key Success Factors

Increased Consumer awareness especially in cost sensitive market segments ESC with high potential to reduce accidents. ESC saves lives. Proved by studies about ESC-effectiveness. ESC is commodity and available in all car segments.

ESC is base for value added functions (safety and comfort) e.g. hill hold control, trailer logic, hill descent control, Brake assist...

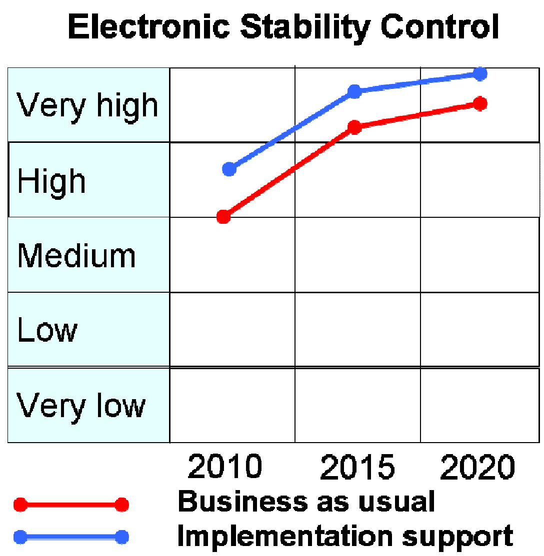
I Feasible Deployment Strategies



According to the V analysis of the implementation of ESC, the measures to be taken include the following:

- the benefits of ESC have been verified in many countries with accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- customer awareness needs to be increased by including and maintaining ESC in the EuroNCAP system, which requires that the identification and performance of various ESC systems in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of ESC, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of ESC.
- customer business case needs to be improved by tax and/or insurance incentives making it attractive to purchase ESC-equipped cars even in the small car segment
- mandation of ESC by the European Commission in all new vehciles from 2012 onwards will increase the market penetration rapidly from that year.

With the help of these measures, the market penetration of ESC in new cars in Europe is forecasted as the following up to 2020:



Implementation Issues for Obstacle and Collision Warning

A System description

Systems detect obstacles and give warnings when collision is imminent. Current solutions with limited performance are a separate feature of Adaptive Cruise Control systems which use information obtained from radar sensors to give visual and acoustic warnings. Future systems will optionally use near range radar sensors or LIDAR in addition to the long range radar. The evolution of the function has been the following: 1) ACC without braking capability, 2) ACC including braking capability but without taking care of fixed obstacles, 3) taking care of some category of fixed obstacles i.e. those with a big equivalent surface to detection.

B Technology Availability

Available as ACC feature as an option in several European models. Safety systems based on long rage radar and additional near range radar sensors or LIDAR to be introduced in 2005.

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

For the systems based on 24 GHz short-range radar, the market penetration must not exceed 7%, automatic deactivation in exclusion zones and no new systems after 2013 due to risk of interference with other systems using the same frequency band. Liability problems need to be solved.

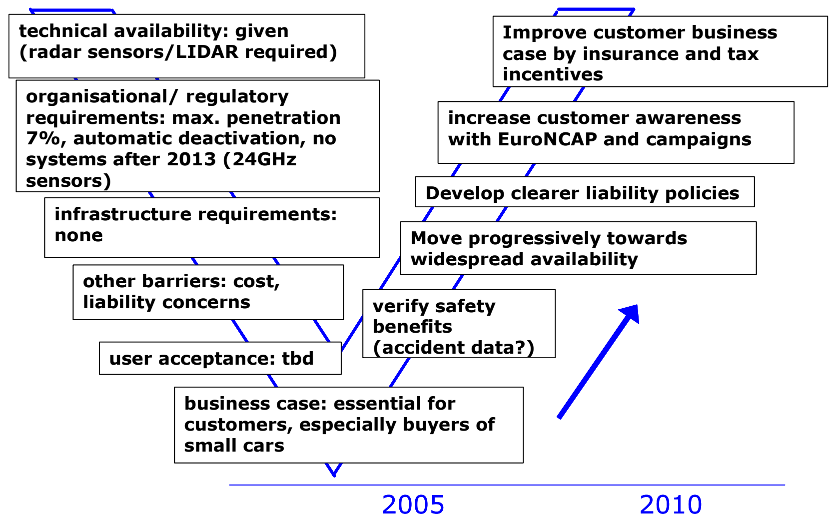
F Security

G Business Case / Customer Awareness and Acceptance

H Key Success Factors

Consumer awareness, willingness to bear additional cost, liability.

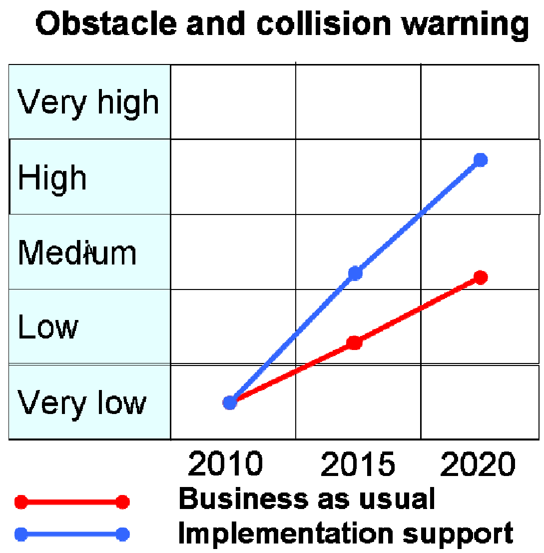
I Feasible Deployment Strategies



According to the V analysis of the implementation of obstacle and collision warning systems, the measures to be taken include the following:

- The safety benefits of obstacle and collision warning systems have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Clearer liability policies need to be created in order to safeguard the customer's interests while not hindering the roll-out of the safety improving systems
- Customer awareness needs to be increased by including and maintaining obstacle and collision warning system in the EuroNCAP system, which requires that the identification and performance of various obstacle and collision warning systems in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of obstacle and collision warning, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of obstacle and collision warning.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase obstacle and collision warning system -equipped cars

With the help of these measures, the market penetration of obstacle and collision warning systems in new cars in Europe is forecasted as the following up to 2020:


Obstacle and collision warning
Very high
High
Medium
Low
Very low
2010
2015
2020
Business as usual
Implementation support

Implementation Issues for Emergency Braking Support

A System description

Based on radar (short and long range), LIDAR and/or camera vision emergency braking support systems provide support in situations with a high risk of a head to tail collision in order to avoid the collision or to reduce the collision speed and the total crash energy. Total crash energy reduction correlates directly to crash injury mitigation. Different levels of support are available: enhancement of driver's braking if necessary, automatic activation of partial braking, automatic activation of full braking.. Some systems also trigger reversible measures of occupant protection.

B Technology Availability

Several systems are already available.

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

none.

F Security

none

G Business Case / Customer Awareness and Acceptance

Consumer awareness should be improved by information campaigns. Incentives given by insurers could accelerate market penetration.

.

H Key Success Factors

Customer awareness, willingness to bear additional cost, driver acceptance (false alarms), liability

.

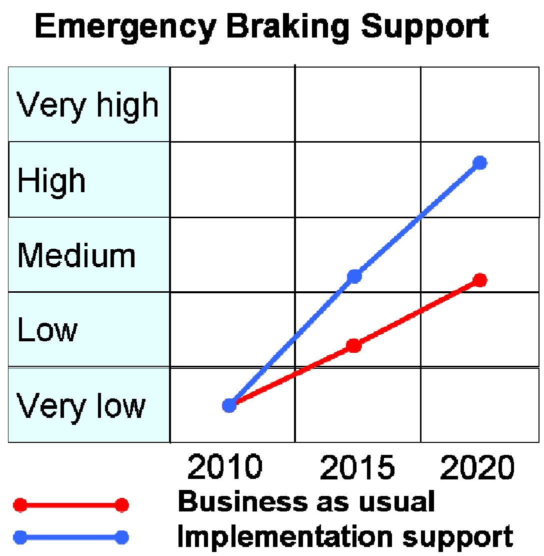
I Feasible Deployment Strategies

The measures to be taken include the following:

- The safety benefits of emergency braking systems have to be assessed in relevant test scenarios. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes the system available in more models of new cars.
- Customer awareness needs to be increased by suitable information campaigns, and the information should also be included in the education programmes of driving schools, automobile clubs etc.

- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase emergency braking system -equipped cars

With the help of these measures, the market penetration of emergency braking systems in new cars in Europe is forecasted as the following up to 2020:.



Implementation Issues for Blind Spot Monitoring Systems

A System description

Systems, which give information/warnings to the driver about relevant obstacles in the blind spot around the vehicle, when the driver intends to change the lane. Systems can use cameras or radar sensors to detect relevant objects.

B Technology Availability

Available as an option in a few models since 2005 in production.

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

For the systems based on 24 GHz short-range radar, the market penetration must not exceed 7%, automatic deactivation in exclusion zones and no new systems after 2013 due to risk of interference with other systems using the same frequency band. Liability problems need to be solved.

F Security

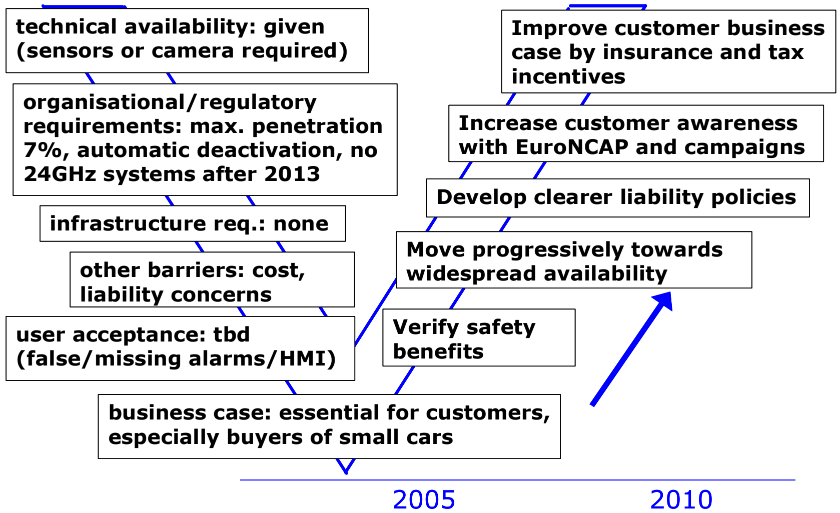
none

G Business Case / Customer Awareness and Acceptance

H Key Success Factors

Consumer information, customer awareness and willingness to bear additional cost, driver acceptance (false/missing alarms, HMI), liability.

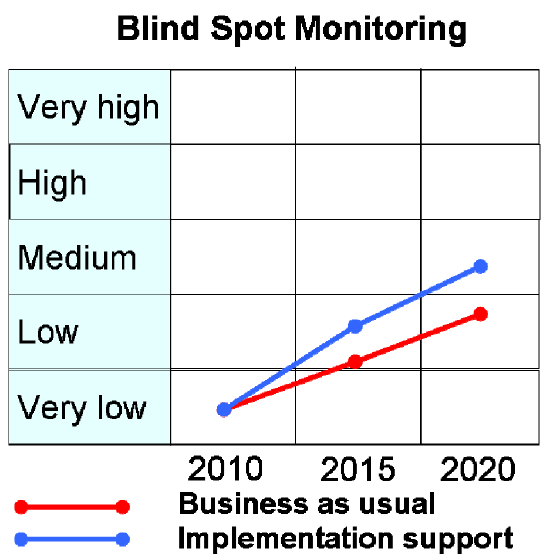
I Feasible Deployment Strategies



According to the V analysis of the implementation of blind spot monitoring, the measures to be taken include the following:

- The safety benefits of blind spot monitoring have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Clearer liability policies need to be created in order to safeguard the customer's interests while not hindering the roll-out of the safety improving systems
- Customer awareness needs to be increased by including and maintaining blind spot monitoring in the EuroNCAP system, which requires that the identification and performance of various blind spot monitoring in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of blind spot monitoring, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of blind spot monitoring.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase blind spot monitoring -equipped cars

With the help of these measures, the market penetration of blind spot monitoring in new cars in Europe is forecasted as the following up to 2020:


Blind Spot Monitoring
Very high
High
Medium
Low
Very low
2010
2015
2020
Business as usual
Implementation support

Implementation Issues for Adaptive Head Lights

A System description

Adaptive Head Lights improve night-time driving safety on twisty roads: the headlamps follow the direction in which the driver is steering, thus extending the illumination range in the relevant areas. In this way it is possible to spot pedestrians, cyclists and animals much sooner.

Conventional headlamps have a range of about 30 metres when entering a corner with a 190-metre centre-line radius. With the Active Light System however, this is extended by a further 25 metres. The Active Light System is based on bi-xenon headlamps with dynamic range adjustment. A microprocessor integrated in the vehicle's electronic data network controls the system on the basis of real-time information supplied by the steering angle and speed sensors. Other possible functions include bending lights.

B Technology Availability

Available as an option in several European models.

C Road and Information Infrastructure Need and Availability

none

D Organisation requirements

none

E Regulatory Requirements / Barriers

Liability problems need to be solved.

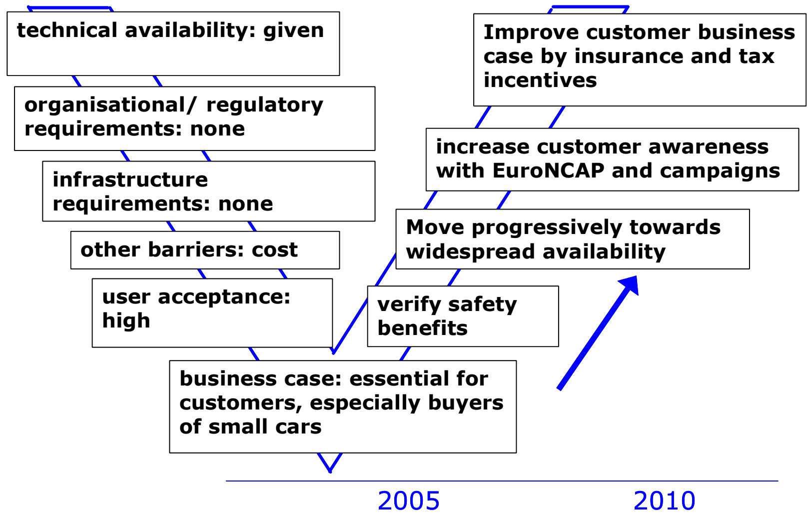
F Security

G Business Case / Customer Awareness and Acceptance

H Key Success Factors

Customer awareness and willingness to bear additional cost, liability.

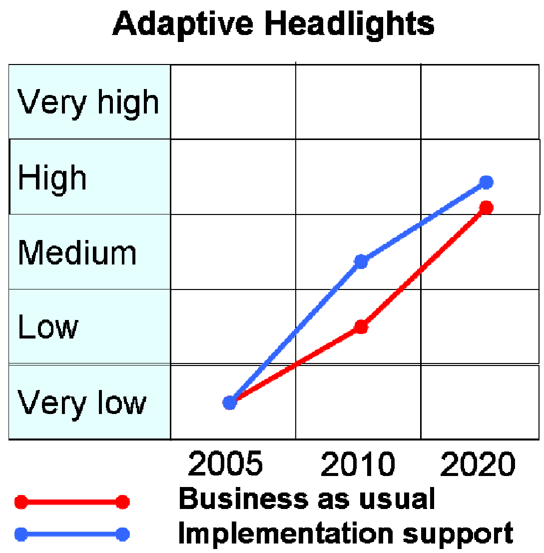
I Feasible Deployment Strategies



According to the V analysis of the implementation of adaptive head lights, the measures to be taken include the following:

- The safety benefits of adaptive head lights have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Customer awareness needs to be increased by including and maintaining adaptive head lights in the EuroNCAP system, which requires that the identification and performance of various adaptive head lights in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of adaptive head lights, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of adaptive head lights.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase adaptive head lights -equipped cars

With the help of these measures, the market penetration of adaptive head lights in new cars in Europe is forecasted as the following up to 2020:


Adaptive Headlights
Very high
High
Medium
Low
Very low
2005
2010
2020
Business as usual
Implementation support

Implementation Issues for Lane Departure Warning Systems

A System description

Warning given to the driver in order to avoid leaving the lane unintentionally. Video image processing is the most important technology. Warnings can be acoustic/ visual/ haptic.

B Technology Availability

Systems have been available for commercial vehicles for several years, just recently introduced in some European and other passenger cars using video image processing technology. Systems are also under research and development

C Road and Information Infrastructure Need and Availability

Good (unambiguous) lane markings

D Organisation requirements

none

E Regulatory Requirements / Barriers

Liability problems need to be solved.

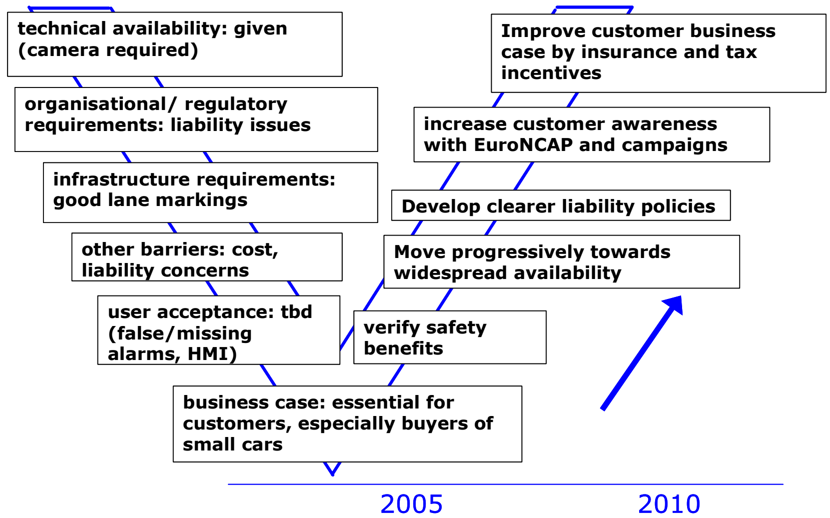
F Security

G Business Case / Customer Awareness and Acceptance

The comfort aspect as well as the safety benefit has to be communicated. Also aftermarket solutions are available, Hence, high penetration rates are possible quite quickly.

H Key Success Factors

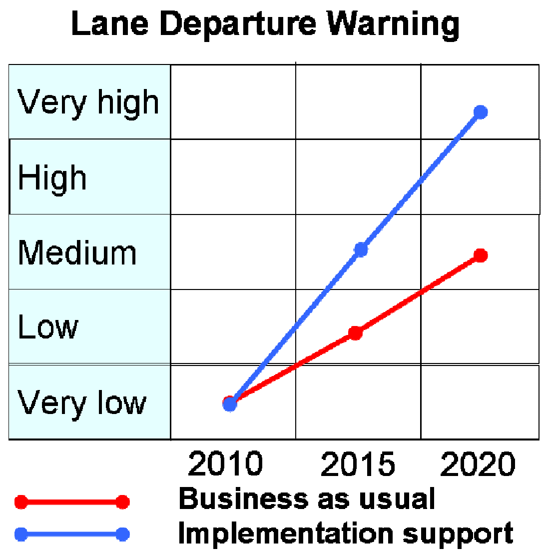
Customer awareness, willingness to bear additional cost, driver acceptance (false/missing alarms, HMI), liability



According to the V analysis of the implementation of lane departure warning systems, the measures to be taken include the following:

- The safety benefits of lane departure warning systems have to be verified in accident analyses. This is essential in order to assure public authorities and insurance companies of the actual benefits before they can make decision on any incentives.
- The industry makes progressively the system available in more models of new cars.
- Clearer liability policies need to be created in order to safeguard the customer's interests while not hindering the roll-out of the safety improving systems
- Customer awareness needs to be increased by including and maintaining lane departure warning system in the EuroNCAP system, which requires that the identification and performance of various lane departure warning systems in different cars can be verified in a satisfactory manner. Information campaigns should be carried out about the benefits of lane departure warning, and the information should also be included in the education programmes of driving schools, automobile clubs etc. In addition, car dealer training should include information of the operation and benefits of lane departure warning.
- customer business case needs to be improved by tax and/or insurance incentives making it more attractive to purchase lane departure warning system -equipped cars

With the help of these measures, the market penetration of lane departure warning systems in new cars in Europe is forecasted as the following up to 2020:



Lane Departure Warning
Very high
High
Medium
Low
Very low
2010
2015
2020
Business as usual
Implementation support

Implementation Issues for RTTI

A System description

"Real-time Traffic and Travel Information" includes all information which is relevant to organize and to optimize traffic flow and which can give advice to the mobile user, usually the driver, and to contribute to road safety and efficiency. The *e*Safety goal is to provide the majority of drivers with actual intra-urban traffic information and to get adequate urban traffic information in 50% of all major metropolitan areas in the EU.

RTTI contains
* the collection of relevant traffic data,
* the interpretation of that information and prepare it for further use and distribution,
* the application of that information to operate infrastructural installations such as traffic lights or moving traffic signals,
* the wireless transmission of the RTTI to the mobile user by public or private broadcast and/or two-way systems such as GSM, GPRS, UMTS, WLAN, Satellite transmission.

B Technology Availability

Beside verbal radio announcements which interrupt the regular audio program, the most commonly used service is RDS/TMC, which is in operation in quite some European countries, already. It offers digitally coded traffic information which can then be electronically selected and interpreted. Very often this is then used to adjust the routing of electronic navigation systems in vehicles to the actual traffic situation (-> "dynamic navigation"). RDS/TMC has a significant user base, which is growing all the time. A growing number of terminals such as in-car navigation sets, PDAs and mobile radios with built-in navigation capability are on the market. According to the eSafety Implementation Status Survey 2007, the market penetration of RTTI as TMC or optional traffic information was in fourteen European countries approximately 5% of all registered cars.

In many European countries, RDS-TMC services are available free of charge for the users. The highest penetration can be seen in Germany, where RDS-TMC messages are transmitted by 10 public broadcasters and 8 private broadcasters within 53 regional or local programs. This means, that full coverage in Germany has been reached and RDS-TMC messages can be received at any place from several programs. During the last years in some countries commercial services have taken up – mainly in France and the UK. These private companies normally operate their own data collection system, but use public data, too, where available. RDS/TMC services are already installed in some of the new Member Countries of the EU, too.

C Road and Information Infrastructure Need and Availability

The systems require monitoring systems of sufficient quality in order to serve the user and have a positive effect on safety and efficiency. The proliferation of RTTI services into further European countries and/or the extension of

services in the countries already equipped is however sometimes hindered by a number of factors, such as
* limited availability of traffic information content,
* difficulties in defining the roles of the public and private sectors,
* cost of broadcasting,
* limited data rate in FM radio,
* and economic difficulties with business models.

The RTTI Working Group group has analysed some of the issues mentioned as being caused by
- the limited capacity in FM which may be removed by using DigitalRadio (DAB)
- the lack of data in most urban areas
- and the lack of some push for starting-up in some European countries.

The RTTI Working Group has proposed to the *e*Safety Forum that all EU-countries should agree or should be advised to enable and to extend the installation of the chain of information needed to establish RTTI services, so to have about 80% of all journeys served with adequate, standardized services in 2010.

<u>D Organisation requirements</u>

To reach the target mentioned above, the RTTI WG recommended to the Member States
* agree at their national level on a strategy and time schedule for the implementation of RTTI services, starting from RDS/TMC, covering as good as possible both interurban and urban areas
* support the Traveller Information Services Association (TISA) to push the safety-related services features of TMC, building on the already existing and standardized European format for the data, messaging and transmission standards,
* take steps to ensure roaming and interoperability across the RTTI services in all of the EU,
* require the authorities to make available existing public data for the provision of RTTI services and to establish additional collection of RTTI when necessary,
* agree, on the basis of the national RTTI strategies and the Commission Recommendation on TTI services, with the private service providers on the extent of the public (free of charge) services and the conditions for the commercial services, and establish public-private partnerships if necessary,
* ensure the correct implementation for the standards by the service providers,
* publish, following the guidance of the Commission RTTI recommendation clear guidelines for the private sector the conditions for establishing private data collection networks for commercial purposes,
* require broadcasters, especially those operating under public licence, to carry the RDS/TMC traffic information on their FM services for public or private providers so that a minimum of 80% of journey drivers has access to a relevant service by the year 2010 or earlier,
* require authorities to ensure through the appropriate standardisation and regulation bodies that frequency spectrum and broadcast capacity will be made

available for the more advanced digital broadcast services such as DAB, DRM, DVB-T and eventually satellite-DAB,
* support the development of more advanced services which are possible by 3G Mobile Communications, DAB, DVB-T and satellite broadcasting, WLANs and others.

The TISA association is aiming to solve some of these issues with its own working groups.

E Regulatory Requirements / Barriers

See D and the proposals made there to get the necessary regulatory requirements installed and the existing barriers removed.

F Security

G Business Case / Customer Awareness and Acceptance

In many European countries, RTTI is run in coordination between the authorities or operators of the main roads, the public and private broadcasters and some automobile clubs. The cost of the RTTI services are then covered by these groups, and no extra charge has to be born by the users. They deliver the traffic information normally free of charge to the broadcasters. These distribute that part of the information to their audience which they feel will be relevant to the road users. Very often they add some more and extra information which they may get from other sources such as the automobile clubs, from local police or organisations.

In case of private broadcasters and Public Private Partnerships some other business cases are applied. The most common one is: Encryption of the TMC-service and a once-per-life down-payment for the car-radio installed into the vehicle.

The existing RTTI-service via RDS/TMC is widely accepted – especially when the service is free of an extra monthly or annual charge. In countries with that service about all navigation systems installed by the car manufacturers have the RDS/TMC-feature installed, already. Due to this the strong expansion by about 1 million customers p.a. in the Member Countries of the European Union is understandable.

The next step expected by the users is a more detailed digital information on the urban traffic situation and so to allow a dynamic navigation in towns.

H Key Success Factors

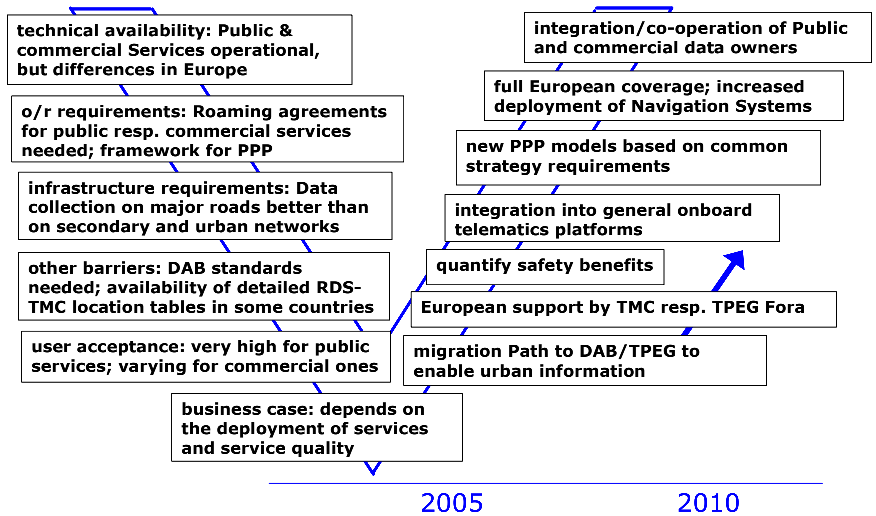
There are many factors for success, the two most important ones may be:

a. Customer's awareness and interest in the RTTI-service, augmented with:
* more and more actual and correct traffic information
* not only warning for traffic problems but giving information of the end – or even the expected time for end - of a traffic problem
* extension to inner-urban traffic information

* eventually extra features such as expected travel times
* reasonable costs

b. enabling of the installation of RTTI-services by the authorities,
* providing existing RTTI-data to the operators and broadcasters,
*and giving support and allowances for private installations – mainly then, when public organisations and communities show no or only small interest to install an adequate RTTI service.

I Feasible Deployment Strategies

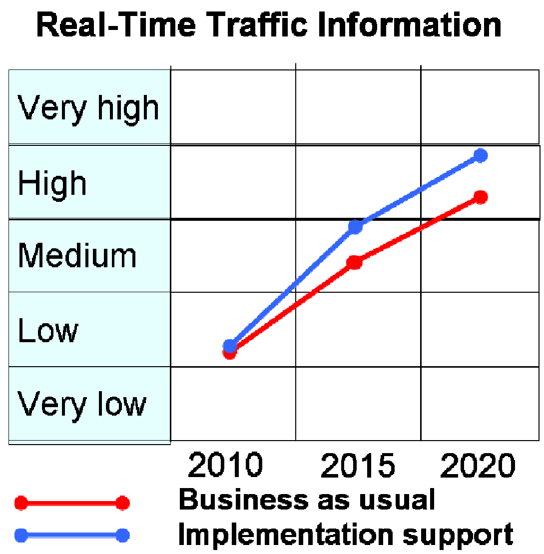


According to the V analysis of the implementation of RTTI, the important measures to be taken include the following:

- All stakeholders to follow the migration path from RDS/TMC to DAB/TPEG (Digital Audio Broadcasting/Transport Protocol Expert Group) so that also urban information can be included in the European services.
- European Commission to provide their support to the member states' and other stakeholders' co-operation in e.g. the TISA activities.
- The benefits of RTTI are acknowledged but the safety benefits need to be quantified with empirical studies.
- The industry and other stakeholders should provide the integration of RTTI into the general onboard telematics platforms in the vehicles.
- The member states, services providers, broadcasters and other stakeholders should develop common strategies and business models to facilitate efficient PPP models for RTTI service provision.
- In order to achieve full European coverage and to accelerate market penetration, the penetration of navigation systems equipped with RTTI should be promoted via campaigns and incentives.
- In order to improve data quality and thereby user acceptance and demand, the co-operation and data sharing between public

and private owners of real-time transport related data should be improved.

With the help of these measures, the market penetration of RTTI in new cars in Europe is forecasted as the following up to 2020:



A more detailed set of recommendations and roadmap is found in the final report of the RTTI Working Group of the *e*Safety Forum.

Implementation Issues for Dynamic Traffic Management and Local Danger Warnings

A System description

Dynamic traffic management systems and local danger warnings are used to increase the safety and flow of traffic in cases of disturbance caused by incidents, congestion and adverse weather. The systems are operated automatically, semi-automatically or manually from traffic control centres based on fixed monitoring systems or mobile sensors (FCD etc.) on location. The systems employ Variable Message Signs or VMS to give the information to the drivers. Three categories of VMS exist based on the types of messages given: 'regulatory messages', 'danger warning messages' and 'informative messages'. The dynamic traffic management systems usually use regulatory messages, sometimes accompanied by danger warning and informative messages, and local warning systems use danger warning messages. New pictograms arise with mixed functions: informing about road closures ahead (informative-to-compulsory); informing about congested exit ahead (informative-to-danger).

B Technology Availability

The technologies needed to implement the systems exist. The VMS signs vary from single matrix devices which can display just one sign/symbol (in on/off mode) via line matrix displays which can display any text or which can display a varying combination of pictograms and text to graphical panels which can display anything. Also combinations of signs/symbols and texts are in use (Multi-purpose VMS). Various technologies are used in the signs, e.g. fiber optics, leds, prisms. The telecommunications between the VMS, monitoring systems and traffic control centres utilise various wire and wireless technologies. The traffic or environmental monitoring systems required by the systems are primarily based on fixed road infrastructure based monitoring stations utilising e.g. inductive loops, microwave detectors, video detectors, infrared detectors, etc. Specific systems are used for monitoring weather conditions.

There are situations for which no pictogram or no satisfactory pictogram exists. New or adequate pictograms may be needed for the following regulatory pictograms: 1) Switch off the engine if congestion persists, 2) Switch on hazard warning lights and 3) High Occupancy Vehicle Lane; Danger warning pictograms: 1) Unauthorised person(s) on the road, 2) On-coming vehicle, 3) Weather conditions such as fog, rain, snow and 4) Vehicle broken down; Informative pictograms: 1) Road-exit closure, 2) Road-exit congested, 3) Lane closure and 4) Tunnel closure, 5) Way to city centre, and 6) Truck Parking.

Major technical issues relate to the future developments in technology and vehicle equipments enabling the use of cars and other motor vehicles as mobile sensors. This means that we need to solve the in-vehicle sensing issues as well as the communication issues, which mainly relate to vehicle-to-infrastructure and roadside-to-control centre communications, but also vehicle-to-vehicle communications. In-vehicle technologies for producing monitoring information required by the systems exist (travel time and traffic status, accidents) or are under development (road surface friction, incidents, pedestrian and animal detection).

C Road and Information Infrastructure Need and Availability

The systems require monitoring systems of sufficient quality. The high quality of the monitoring information input is essential to the high quality operation of the dynamic traffic management and local warning systems, which in turn is directly linked to the effectiveness of the systems. The type and quality of the monitoring system are dependent on the aim of the traffic management and local warning system as listed below.

- Speed management /speed harmonisation (traffic-related): Cross-section traffic parameters (traffic flow by vehicle class; spot speed – average and standard deviation; occupancy) and/or queue length and/or camera output
- Speed management (weather-related): Cross-section road weather information (temperature - air, road, ground, dew point; precipitation; visibility; wind - speed, direction, gusts) and cross-section or continuous road surface condition information (water/snow existence; black ice existence; friction; levels of salt on road); additionally camera output
- Ramp control/metering: Cross-section traffic parameters and queue length on motorway and ramp
- Network traffic control: From main parts of network cross-section traffic parameters and/or link travel times and/or queue lengths; camera output
- Lane control: cross-section traffic parameters lane by lane; camera output (geographical position of stationary objects , e.g. vehicles); automatic incident detection
- Tunnel control: cross-section traffic parameters; queue length, camera output; automatic incident detection; automatic fire detection, stopped vehicle detection
- Bridge control: cross-section road weather information (especially wind - speed, direction, gusts and black ice); cross-section traffic parameters
- Incident warning: Output from Automatic Incident Detection (AID) systems or cross-section traffic parameters; queue length; camera output;
- Local warnings (school children): Output from pedestrian detection system, or manual or clock-based trigger system
- Local warnings (large animals): Output from animal detection system
- Local warnings (slipperiness): Cross section road surface information
- Local warnings (queue): Cross-section traffic parameters; queue length; camera output
- Other systems: hard shoulder availability (intensity of traffic flows; specific VMS in use; operations: open, closed, leave hard shoulder).
- Intelligent truck parking (number of places available, services offered, free/tolled condition)

D Organisation requirements

The systems are currently usually fully operated by traffic control centres under the jurisdiction of the road operator/authority or the police.

The use of data from in-vehicle systems to improve the quality of the monitoring systems will require new organisation-related solutions.

E <u>Regulatory Requirements / Barriers</u>

Both regulatory rules and warning messages shall be indicated on VMS's with symbols as prescribed by the Vienna Convention (1968), and texts shall be minimised. Supplementary brief texts according to the Vienna Convention can be used. This could also be extended to informative and advisory messages on VMS's. This is especially recommended where these messages along the Trans European Road Network (TERN) are meant for all drivers, thus including a growing percentage of foreign drivers, avoiding language confusion. (CEDR 2003).

The current representation of regulatory rules on the European VMS's almost completely conforms the signs of the Vienna Convention. This seems to be rather evident as they have the same legal status/value everywhere in Europe. Regarding danger warnings, the different approaches of the European states already appear, ranging from warning signs conform the Vienna Convention to entirely textual descriptions which may vary per region. The differences between the European states are most apparent with informative signs. Where the Vienna Convention gives some recommendations for informative signs like (non-variable) directional signs, it does not contain prescriptions nor recommendations for pure textual messages on VMS's. This lack probably is the cause of the variety of the national and local guidelines which describe these panels in more detail. Besides the fact that each county/region currently uses its own language, they also apply different national and even local approaches to the use of VMS. The common practice of VMS in the CEDR member states shows a mixture of different languages and, in some cases, 'invented' pictograms which are not being used all over Europe or which are an interpretation of the Vienna Convention. One key question is using always "rich" pictograms that integrate a lot of information (specific and consequence oriented) hence minimizing or eliminating the need of complementary text.

The most harmonised areas are the colours and the use of symbols and pictograms in regulatory and danger warning message signs. In some cases the harmonisation is based on practices and the development should be followed and kept consistent. Examples of already harmonised objects are light emitting (e.g. LED or fibre optic) signs with inverted colours in speed limit systems and in danger warning signs on main roads; a red circle indicating a mandatory speed limit; avoidance of text messages in lane control; small amount of information; no unnecessary information; pictograms instead of text messages and, combined messages; no flashing warning signs; and approval procedures for new pictograms.

The accident pictogram (a variation of the pictogram suggested by COST30bis, 1985) has been promoted within the last RE.2 at the UNECE level. However, the use of the accident pictogram is not recommended (rises distracting expectations and do not say much about the specific road context one should expect). An alternative is to show the consequences of the accident i.e. to just show the congestion pictogram. The current definitions for the maximal length of text messages are not equal, except for the definition for number of lines, and they should be made more uniform. If a text message is shown, it should be as short as possible and have minimal amount of the words. Internationally understood expressions or symbols (e.g. ←,→,↑,↓,‹,›,+,-,=) should be preferred.

The liability issue has delayed the deployment of VMS in some cases. The problem is due to cases where a danger warning message is not displayed, although the danger (about which the system should warn) is present at the location, and the driver interprets the absence of warning as an indication of no danger and then is involved in an accident or a near-accident due to the danger event. Liability is very much connected to the reliability of the system and its control algorithms and monitoring infrastructure. The final responsibility lies in any case with the driver.

For all deployments the reliability of the systems is important. Information on the qualities of VMS is occasional or does not even exist, but the quality should be controlled. Sitting criteria should be specified in national guidelines. There is a substantial variation in the control principles both nationally and between countries. A more harmonised use of variable warning signs would be beneficial to the drivers. For this purpose the documented principles should be collected for the common use and analysis.
In long term, the differences in the use of pictograms should be minimised. For text messages, the approval procedures should be developed. The existing message prioritisation practices should be discussed and evaluated.

F Security

The issue of security has been recently raised concerning the question of Intelligent Truck Parking and related services. This issue reflects a double need of truck drivers: safe parking in order to avoid driving beyond scheduled legal times and safe loads, free from spoiling or stealing.

G Business Case / Customer Awareness and Acceptance

Road users find the systems useful, and usually comply well with the regulatory messages and danger warning messages. For these reasons, the systems have been also found to be very effective for reducing the risk of accidents and their consequences. The systems are, however, quite costly to implement and to maintain (keeping the system accuracy and credibility, and responding to the new coming situations that need new signs). The systems are usually only installed if the expected benefit-to-cost ratio is high enough.

H Key Success Factors

There are considerable costs involved in the implementation of VMS systems. The extent of the costs are naturally linked to the location, the objectives of the system, the VMS signs, control system, monitoring infrastructure required, communication systems etc. The costs of route and network control systems on motorways are in the range of 0.15-0.2 M€/motorway-km, and of a line control (speed management) system on a motorway can be estimated to be in the range of 0.05-0.1 M€/motorway-km and the investment cost for one VMS

in a larger system to be 15 000 – 30 000 €. The annual maintenance and operation of the systems can be 5...10% of the investment costs.
For most road authorities, the decision to implement the system will be based on the benefits of the system in comparison to its costs. The main benefits of the systems come from improved safety and efficiency. Evidence exists of an accident reduction of 25% from motorway traffic management systems, a 13% reduction in wintertime injury accidents due to dynamic weather related speed management systems. The benefit/cost ratio of the system will depend much on the location, accident situation and traffic volumes, e.g. the benefit/cost ratio for a motorway control system on a motorway with average daily traffic volume of 95 000 vehicles was estimated as 5.6. Concerning local danger warnings, studies indicate injury accident reductions of 5-15%.

A key success factor is to maintain and improve the effectiveness of the systems while keeping costs at a reasonable level. The former is ensured by high quality of the systems and high user acceptance enabled by the efficient and understandable control of the VMS and supported by the harmonised deployment of them on the European level. The latter is supported by the increasing use of mobile, in-vehicle based systems for producing the necessary monitoring information required. Cost-benefit can be improved by integrating different harmonisation processes: VMS, in-vehicle, navigators, road kiosks and the internet. The same pictograms and possibly message structures should portray the same situations through the different display devices and so their understanding could mutually reinforced though different contexts and nations.

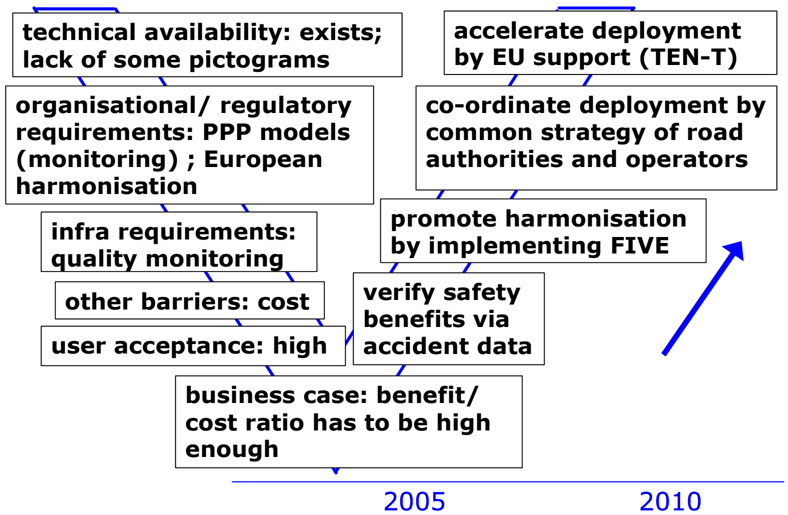
I Feasible Deployment Strategies

CEDR (Conference of European Directors of Road) has worked for many years toward the implementation of harmonised VMS based traffic management and danger warning systems in Europe. The last efforts have been the FIVE action as well as the VMS Platform funded by the UK but terminated in the spring of 2004. A successful implementation of the harmonisation of VMS around Europe - and setting up a Platform to coordinate that work - depends first and for all on the willingness of the NRA's to implement the FIVE Framework. A CEDR Sub-Group on Telematics has been asked to present a TERN deployment strategy for VMS (Implement FIVE) and to seek a structure to implement this strategy.

For VMS harmonisation, we apparently need today two teams: the legal team and the working team.

The main body concerning VMS harmonisation (the legal team) is not, to my view is WP.1 at the UNECE level. European nations having ratified the 1968 Convention will adopt UNECE dispositions concerning VMS. UNECE, however, has not money nor technical resources: they can only receive good proposals, evaluate them and accept or reject them. Hence, WP.1 should be fed with ideas and recommendations concerning VMS.

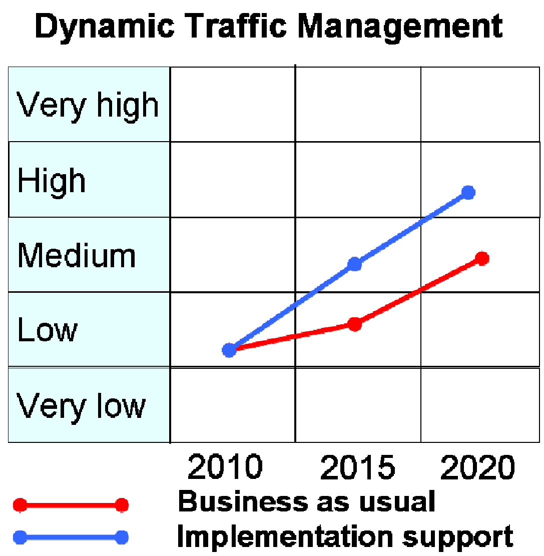
The working team is required for this purpose and it needs to be made of people directly involved with the VMS reality and needs, people able to fix priorities at the specific level and to get together frequently (5-6 meetings a year and electronic work). Currently, this team is made up by EasyWay European Study ES4-Mare Nostrum. ES4 "feeds" WP.1 through the so-called VMS Unit. CEDR and its member NRAs are among the membership of ES4.

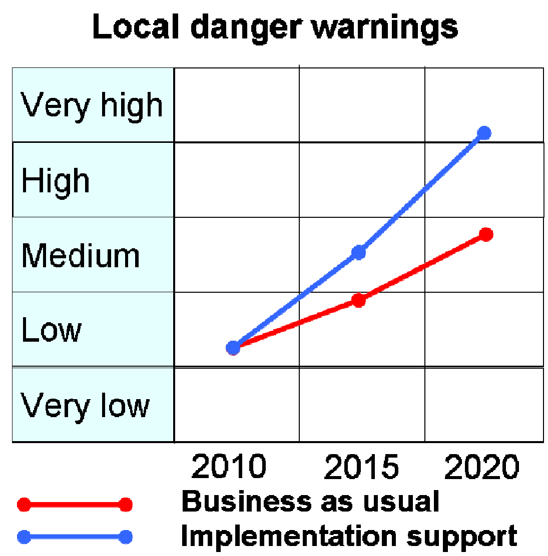


According to the V analysis of the implementation of dynamic traffic management as well as mainly infrastructure based local danger warnings, the measures to be taken include the following:

- The safety benefits of all new types of systems need to be verified with actual accident data in controlled before and after studies.
- The implementation of the FIVE framework should be ensured by the European road authorities and operators in order to achieve the harmonisation according to user needs and requirements.
- A common European strategy for deploying and operating dynamic traffic management, loac danger warning and also other infrastructure-related *e*Safety systems should by developed and maintained by the road authorities and operators together with the other stakeholders
- The European Commission should continue to provide their funding support to the deployment of these systems within the context of the TEN-T programme and also with other instruments to ensure the deployments on the critical road sections outside the TERN.

With the help of these measures, the market penetration of these systems for problematic parts of the European road network is forecasted as the following up to 2020 for :





Implementation Issues for Extended Environmental Information

A System description

The idea of Floating Car Data (FCD) is to monitor individual vehicles to gather data concerning the traffic situation on the whole road network. The in-vehicle equipment records the location of the car, speed and possibly other information such as acceleration or deceleration, and sends the recorded information to the central system or to other cars. The central collected data can be used as content for different applications and services. Floating car data can also be implemented as a decentralised system as in the German FleetNet project.

B Technology Availability

The technology needed to implement FCD systems exists. There have been several implementations with varying features. Trials have been carried out and actual FCD deployments exist in Europe (e.g. France, Germany and UK), USA and Japan. Technological solutions such as the wireless communication and location systems used vary from one case to the other. In addition to speed and location, many other kinds of information can be collected. First FCD systems transmitted travel times and locations out of range-outs or time-outs. Enhanced methods compare the onboard travel times with expected travel times to transmit only travel times which exceed a certain threshold value. Different kind of sensors can be mounted in the car and the results of measurements transferred. In modern vehicles numerous control devices and subsystems generates data which can be used by intelligent algorithms to detect traffic situation and safety relevant events and situations (Extended Floating Car Data – XFCD). For example, the operation of ABS brakes can be used to detect slippery road conditions.

C Road and Information Infrastructure Need and Availability

In case of floating car data no roadside equipment is needed. Satellite location systems and means of communication between cars and central system exist. Usually, the location data is produced by a GPS receiver. In future, the corresponding European system called GALILEO together with GPS offers complementary added value compared with either on their own. GPRS, GSM, UMTS, WLAN can be used for wireless communication. At present, GPRS is widely available and offers packet switched data connection which is cheaper to use than circuit switched GSM data.

Methods for the data fusion of the data from different sources (stationary detectors, floating cars, manual reports) are needed and are already used for travel time and traffic status FCD by e.g. ITIS in the UK. The system also requires centres, which receive the various data and where very actual and precise information of local hazards, traffic and road conditions (slippery roads, fog etc.) will be prepared.

D Organisation requirements

The floating car data are collected from individual cars. At least, there should be an organisation which defines standards for the in-car equipment and an organisation to take care of the overall maintenance of the system. The same

organisation could also be responsible for the further development of floating car data system. An organisation is also needed to deploy and maintain local transmitters and/or receivers to collect/distribute FCD and local information as well as to maintain the real-time data pool. It is likely that in most cases a public service actor needs to be involved e.g. via a Public-Private-Partnership (PPP).
In order to avoid the development of further proprietary systems, it is necessary to set up standardization committees in early development stages. The ISO International Organisation for Standardisation in its Working Group TC 204/Subworking Group SWG 16.3 for vehicle probe data for wide area communication is already working. Their new work item proposal contains "Architecture, Basic Data Framework and Core Data Elements"

E Regulatory Requirements / Barriers

Data protection and privacy issues should be dealt with when the system gathers data on the movement of individual vehicles. Questions related to the ownership of the data collected must be answered before starting the implementation.

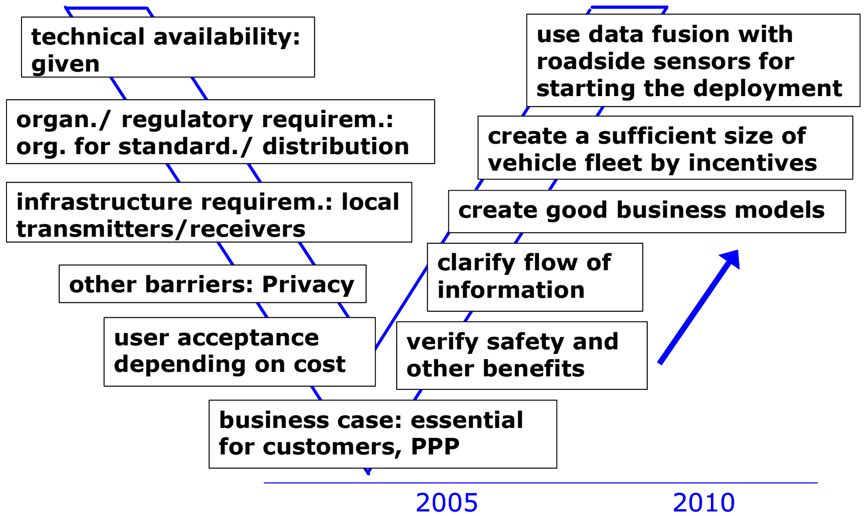
F Security

G Business Case / Customer awareness and Acceptance

Monitoring traffic with conventional roadside equipment is costly. FCD could be one way to produce real-time data for traffic control purposes. A part of the cost could be paid by the authorities paying for the data while the other part can be recovered by the value of real-time services (such as prediction of travel times) offered to the public. In addition, the business model chosen should be feasible with the technology used. New generation of extended floating cars will transmit only data which are relevant to know in the centre: e.g. detected slippery conditions on the road, congested traffic with precise located congestion fronts and weather related visibility obstructions (fog, snowfall). To avoid unnecessary repetition of in-vehicle message feedback-channel-referencing has to be implemented. Every message sent over the air (digital audio broadcast-DAB, traffic message channel-TMC) into the vehicles contains what the centre already knows and does not need to get informed. An intelligent message management in the vehicles with feedback channel referencing will keep the number of send messages explicitly low. Special attention needs to be given to deletion of outdated messages.

H Key Success Factors

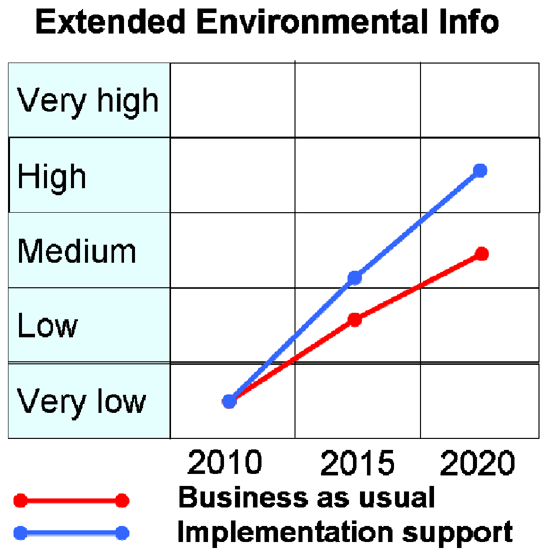
One of the most crucial issues is, who will pay the costs and why. There should be a valid business model or a way to share the costs between different parties concerned e.g. in a PPP. Data protection and privacy issues should be taken account when designing the system to minimize the potential for abuse the data collected and to ensure the user acceptance.
Important is to send all Floating Car Data of a geographical area into one single data pool in order to get the highest quality of content for the services. It doesn't make sense to have numbers of data pools, each with some data.



According to the V analysis, the measures to be taken include the following:

- Verify the safety and other benefits as well as the benefit/cost ratios in different conditions and test the technical performance of the system in large scale demonstrators
- Clarify the flow of information between the vehicles and the FCD servers as well as between FCD servers and traffic information or management centres (both public and private) while maintaining privacy of equipped vehicles
- Develop good business models for European conditions in the context of large demonstrators so that all stakeholders including the drivers have a sufficient business case
- Create a sufficient size of vehicle fleet, usually 5-10% of vehicles on a network is sufficient. In order to quickly reach the required critical mass, the deployment is perhaps best to do one area at a time
- Improve and maintain data quality by co-operating and carrying out data fusion with the owners of roadside monitoring infrastructure

With the help of these measures, the market penetration of extended FCD in new cars in Europe is forecasted as the following up to 2020:



Implementation Issues for eCall

A System description

eCall is targeted by the European Commission to become a harmonized European emergency service, which is based on precise satellite positioning and additional information of vehicles involved in a severe accident (vehicle identification, time of incident, eCall qualifier, identification of service provider as described in a minimum set of data or MSD). Severity will be defined from a personal injury point of view. The generated information will then be sent to a Public Service Answering Point (PSAP) or another type of certified first level emergency centre via a mobile phone connection. It is the intention that the eCall is triggered off by dialling the European emergency number 112 either automatically (deployment of airbag or (later on) crash sensors) or manually (press of a dedicated button). When a voice connection to the next PSAP is set up, accident and vehicle related data (MSD) are transferred through GSM/GPRS communication, using the same channel. In a second phase, it might be possible that when the customer has a contract with a private emergency service provider, additional information (full set of data) could be sent to this service provider, filtered, completed and made available for the responsible PSAP. As the contractual optional connection to a private service provider is flagged on the operator screen at the PSAP the operator might pull down these additional information via the Internet. A possible valuable service might be language/translation service in case the accident happens in a different country and the accident victim has no knowledge of the local language. The PSAP, the emergency centre or service provider has to be able to receive and process the voice call and data set. The information is then sent to the local emergency authorities in order to dispatch the necessary emergency vehicles. The service should work in principle all over Europe.

B Technology Availability

Vehicle integrated GSM/GPRS communications	only available in part of the vehicle park, but the percentage is slowly increasing
Roaming to overcome language difficulties	conference call via private service provider or local language. Only very large PSAPs are able to serve many languages
Low cost in-vehicle communication system	not available yet in Europe to create volume market. Mainly integrated either in embedded navigation systems or Telematics Units
Emergency call routing all over Europe	European call and SMS routing through private network only. Not available in all member states. No public crossover systems exist

PSAP receiving technology	theoretically available, however, implementation depending on E-112 roll-out. In-band-modem software provided licence free but investments needed to up-grade to receive E112 calls.
Vehicle sensors	Airbag deployment sensors used in existing applications. Might be completed later with other types of sensors.

C Road and Information Infrastructure Need and Availability

GPS Information	available in small part of the fleet but increasing together with strong growth in embedded and nomadic navigation devices; available in most HGVs (Heavy Goods Vehicles)
Road infrastructure	not necessary but traffic accident information could be displayed on variable message signs to avoid rear-end collisions
GSM Communication Technology all over Europe	future of GSM in Europe unclear
Receiving technology in PSAP's and others	theoretically available, implementation depending on E-112 roll-out map

D Organisation requirements

Collaboration with and between all EU Member States (EU-25) and other key stakeholders of the emergency value chain in Europe

All stakeholder representatives have to get involved in detailed discussions to work out necessary plans and solve open questions, in particular solve the commercial aspects, regulatory and data protection issues. Commission invited the signees of the MoU to start national and/or regional implementation/roll-out platforms in the beginning of 2009.

Development of and agreement on a business plan before starting the system development and implementation

Development of and agreement on an implementation (roll-out) plan before starting the system development and implementation

Receiving PSAP infrastructure needs to be specified, tested and in place

eCall system architecture, standards, protocols and interfaces need to be agreed in advance before development of in-vehicle systems. Simultaneously the necessary receiving infrastructure needs to be prepared.

Vehicle model cycles and starting dates for vehicle production must be considered, taking into account vehicle type-approval.

Matching of voice calls and data sets (technology).

Roaming requirements must be solved.

E Regulatory Requirements / Barriers

Data protection and privacy issues have been solved but liability issues still open. Legislation not harmonized across Europe.

F Security

Misuse of the systems and the data needs to be avoided. Emergency frequencies need to be dedicated and protected against manipulation

G Business Case / Customer Awareness and Acceptance

The interest of drivers and customers to pay for emergency call activities is rather low. As long as the customer is not made aware about the benefits of a harmonized European emergency call service he/she is reluctant to pay for this service. The current situation of different state of deployment of rescue services and gaps in rescue chains in different European countries is making it difficult to find common solutions.

Today there is no business model discussed and accepted among the different stakeholders. The ECDG (eCall Driving Group) has identified significant savings in the health and social cost side outnumbering the investment needs in in-vehicle systems and infrastructure. Models of tax and financial incentives have been presented and discussed. So far no agreement is reached. . The results of the new eCall Assessment study will allow progress on the Business Case area, while European FOT should increase customer awareness of the benefits of the service.

H Key Success Factors

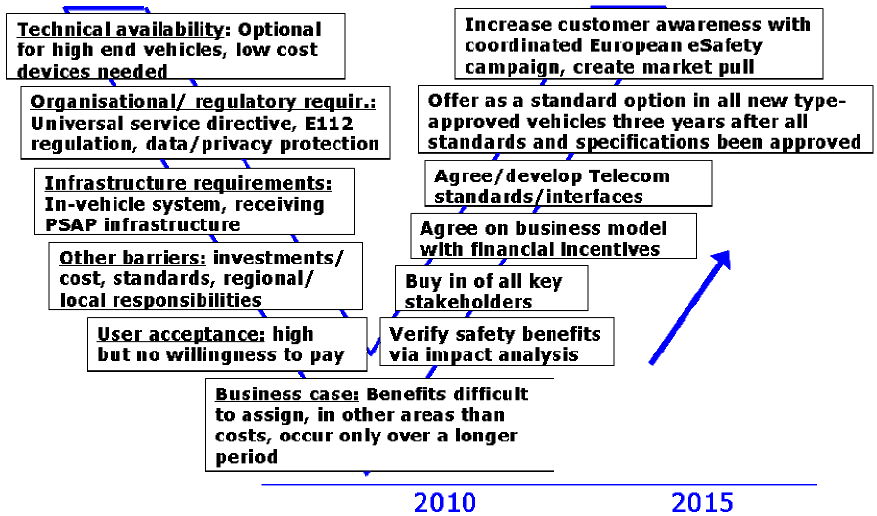
The commitment of the larger EU member states, where the major traffic volume takes place, is key.

Availability of suitable technologies in the Member States and in the vehicles

Availability of an accepted business model by all involved stakeholders (financially, technically and organizationally) leading to positive business cases

Availability of an accepted implementation plan by all involved stakeholders (financially, technically and organizationally)

I Feasible Deployment Strategies



According to the V analysis of the implementation of eCall and the roadmap produced by the eCall Driving Group, the measures or the roadmap to be taken include the following, taking into account the rollout plan delay due to the missed deadline for MoU signatures by June 2005:

- Verify the safety impact of eCall in European conditions with actual European accident data
- Form "eCallNet" consortium and establish financial support for it
- MoU (Memorandum of Understanding) signatures from all key stakeholders of the eCall service chain including the member states – December 2005 (EC)
- Commission to adopt 2nd eSafety communication with actions for the member states and industry – September 2005 (EC)
- eCall Business Model prepared for decision taking by key stakeholders including insurances – June 2006 (All)
- ETSI standardization and eCall interface – starting 2006 (ETSI)
- Implementation and rollout plan prepared for decision taking – first attempt 2006 (All)
- Start system development – after standardisation is finally adopted (ACEA)
- Rollout of infrastructure in key member states – after standardisation is finally adopted (MS)
- Full-scale field test by "early adopter" member states – until Dec 2008 (EC/MS)
- Finalize infrastructure in all other Member States and staggered introduction of eCall as standard option – Sept 2010 (MS, ACEA)
- Promote customer awareness by campaigns and attempt to improve business case by incentives

The eCall Roadmap has been changed in the last years due to the delay in some of the deployment strategies, namely:

- Standardisation: new date expected for the finalisation of the standardisation work within ETSI and CEN is now 2nd quarter of 2009.

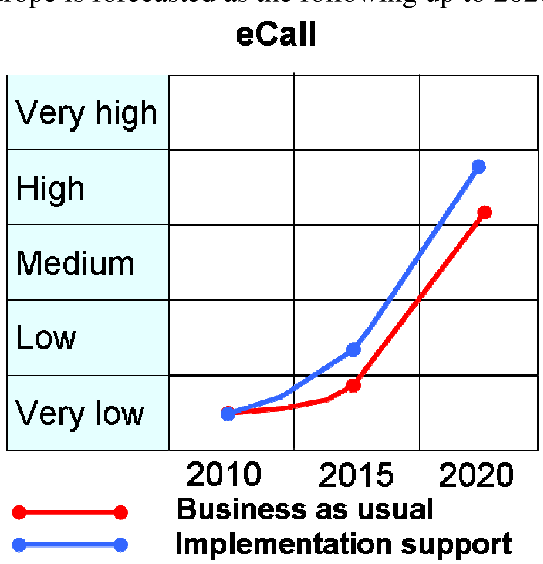
- Not all key stakeholders have signed the MoU. France,UK and 11 others are still missing.

- eCall Business Model issues on hold

- Rollout of infrastructure only started in few MS due to lack of decision concerning standardization

Taking into account these delays, the last date communicated by EC (September 2010) for the eCall introduction as an option in all new-type approved vehicles seems difficult to be achieved. According to the current status standardization and approval work will probably last until end of 2009. Industry would then need three years to offer eCall as a standard option on all new type-approved vehicles after this date.
This might bring eCall implementation to end of 2012.

However, with the help of these measures, the market penetration of eCall in new cars in Europe is forecasted as the following up to 2020:



Implementation Issues for Speed Alert

A System description

The system alerts the driver with audio, visual and/or haptic feedback when the speed exceeds the locally valid legal speed limit. The speed limit information is either received from transponders in speed limit signs, from vehicle camera for traffic sign recognition or from a digital road map, requiring reliable positioning information. Some open questions exist such as:

- Voluntary or mandatory equipment of vehicles
- Type of speed limits to be included: General regulations, local speed signs, temporary speed limits (e.g. "70" between 07.00 – 10.00h), dynamic speed limits depending on traffic and other conditions
- Road categories to be included: motorways, rural highways, urban roads
- General deployment for selected road categories or equipment of specific parts of road networks, such as accident black spots, tunnels, bridges
- Types of vehicles to be equipped: all vehicles, passenger cars, lorries, hazardous goods transports, buses,
- Categories of road users to use speed alert: all drivers, young/aged drivers, drivers under rehabilitation, commercial companies/drivers, other specific groups
- Definition of architecture (e.g. dynamic speed limits require infrastructure link)
- Legal relevance of speed alert for e.g. enforcement
- Availability and update procedure for European-wide database of legal speed limits that is standardised, certified and reliable
- Business model for the system including its whole life cycle

B Technology Availability

The basic technology needed to implement speed alert systems exists. There have been several successful large-scale tests with varying speeding feedback solutions, and voluntary speed alert or limiter systems are on the market. However, suitable solutions need to be achieved on how to convey speed limit modifications to on board units (OBUs), e.g. electronic Map on CD-ROMS, local short range communication, wide range communication (DAB) or traffic sign recognition cameras.

C Road and Information Infrastructure Need and Availability

The basic information infrastructure required by the system, i.e. up-to-date fixed speed limit information in digital road Map, is only partly available in Europe for all roads in Finland and Norway, and in the near future Sweden, and limited coverage (motorways and main roads) for a large part of Europe. Currently, European road authorities and map providers work together in the ROSATTE project to develop harmonised exchange platform to improve availability and accessibility of speed limit information for optimal integration into digital maps. This initiative is also supported through the ITS Action Plan priority "Optimised use of road, traffic and travel data".

The systems based on traffic sign recognition do not require anything from the infrastructure sign except that the speed limits signs should comply to existing standards and regulations concerning them.

D Organisation requirements

There has to be an organisation responsible and liable for updating the speed limit data banks in regular time cycles, as soon as speed limits are changed, and for the actual update reporting procedures. The organisation responsible for conveying temporary and variable speed limit information is required, if they are included in the system.

E Regulatory Requirements / Barriers

In order to have a nation- or European-wide implementation of the system, the following aspects have to be solved: data quality requirements, questions of responsibility, liability, updating, timing of the updating, legal relevance of speed alert systems and speed limit signs as well as their possible contradictions.

F Security

As speed alert application is an information and warning system without any intervention on the vehicle control, security aspects are not fundamental. As long as the application relies only on digital maps to access to static speed limit information and information updates come from new CD / DVD releases, the security risk is very low. Security issues arise from the infrastructure - vehicle communication used to provide dynamic speed limit information (variable speed limit and temporary speed limit) and updates of static speed limit information. The consequences of hacking this communication, and transmitting incorrect speed limit information to all drivers should not be neglected but also not overestimated, the driver being still in control of the vehicle. This is a security issue common to all in-vehicle applications exploiting vehicle-infrastructure-vehicle communications.

G Business Case / Customer awareness and Acceptance

So far, there has not been substantial market (car buyer) demand for the system. The market demand for speed alert will probably be increasing in the future with the expected increase of automated speed enforcement throughout the EU. The growing awareness for traffic safety issues among organisations and the use of speed alert as a tool to ensure delivery of safety quality-assured transport services for a company might also increase market demand. It is also obvious from the pilots that user acceptance for speed alert will increase with increasing familiarity with the system. The large majority of portable navigation system are providing speed limit information, and many also a speed alert functionality showing how the current speed of the vehicle differs from the speed limit. Many vehicle manufacturers are since 2008 using camera-based traffic sign recognition technology that can read traffic sign (speed limits and other traffic restrictions) and display the information on the dashboard, and this is another basis for speed alert. The same camera is also used for other purposes than speed alert, thereby improving the business case.

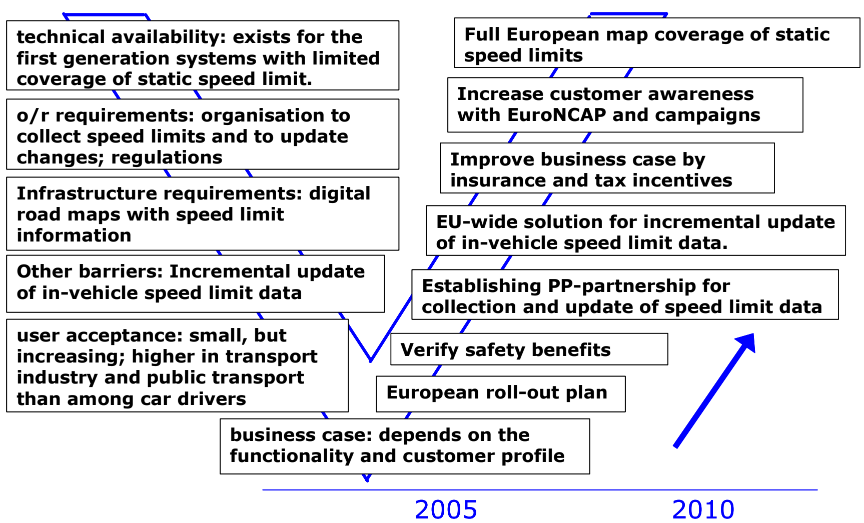
H Key Success Factors

Many road and other authorities are regarding speed alert as a key system for improving road safety, and the large-scale implementation in the short-term will depend on European and national regulations aiming at mandatory or voluntary deployment of the system. European and national decision making will, however, require that the open questions as listed above will be settled. The most urgent factor for the map based systems is the need for an accurate and up-to-date speed limit database that is readily accessible to all potential service providers.

I Feasible Deployment Strategies

Together with another EU project PROSPER, SpeedAlert has developed the European wide deployment strategy for informative and voluntary-based speed alert. The SpeedAlert project has established a common classification of speed limits in Europe, defined the system and service requirements of in-vehicle speed alert system, defined the functional architecture of speed alert, harmonised the definition of speed alert concepts and identified the requirements for standardisation. The project has built consensus with all key stakeholders leading to the definition of recommendations and associated deployment roadmap for successful European-wide implementation.

It is quite likely that deployment has to build on voluntary systems. In a longer perspective mandatory systems could be deployed for certain customer groups, such as learning drivers, frequently caught speeders, drivers wishing for insurance bonus etc.

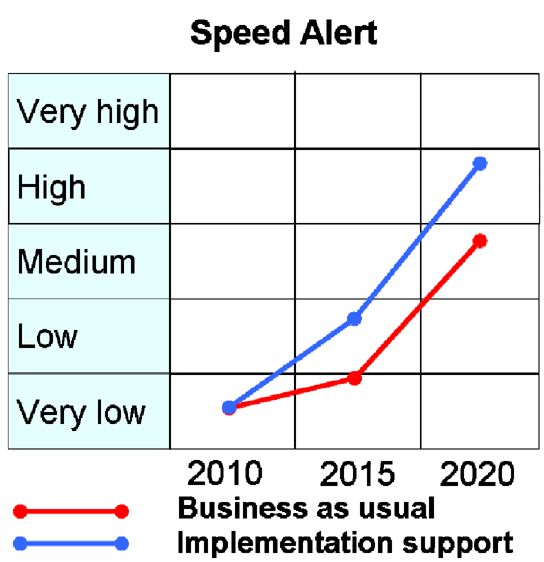


The V model is also based on the work of the SpeedAlert project. According to the roadmap produced by the SpeedAlert project (www.speedalert.org), the following measures need to be taken to promote the deployment of informative and voluntary speed alert systems:

- In order to deploy an autonomous system for static speed limits with limited coverage and to reach a consensus by all stakeholders for speed alert deployment by 2006:

        - Establishment of European roll-out plan endorsed by public and private sectors
        - Assessment of technical and economical feasibility of speed limit data collection and maintenance at European level
        - Development of cost/benefit analysis and business case
        - Promotion of tax/insurance incentives to strengthen end-user interest in speed alert applications
    - In order to deploy an enhanced autonomous system for static speed limits by 2009
        - Ensuring the European-wide procurement of speed limit data by progressively establishing appropriate public/private partnerships
        - Development of adapted procedures to optimise the speed limit data maintenance process by public authorities
        - Development of action plan to support market introduction of incremental map update solutions to enhance in-vehicle speed limit up-to-dateness
    - In order to deploy a cooperative system for variable speed limits and to have speed alert applications as standard option in all new cars by 2015:
        - Deployment of pan-European standardised infrastructure-vehicle communication service for provision of dynamic content
        - Implementation of appropriate certification process of speed limit data to support exploitation by ADAS applications

With the help of these measures, the market penetration of speed alert in new cars in Europe is forecasted as the following up to 2020 for :



Implementation Issues for Dynamic Navigation

A System description

The system of dynamic navigation describes the use of current traffic data for adjusting the routing process with electronic navigation systems. This enables road users to avoid routes with accidents, roadworks, road closure, closing of road, and overall traffic jams in "real time". The Traffic Message Channel (TMC) provides basic services that are established through a European-wide compatibility of receivers and free or low-cost provision of traffic relevant information for most countries in Europe. The current network used for receiving these kinds of traffic information is based on a RDS infrastructure.

More enhanced and individually sourced content in the area of traffic information has been used to improve the standard TMC services in terms of accuracy and quality. For these kinds of services other networks are necessary and currently GSM networks are used to enable a more advanced dynamic navigation.

The availability of real time traffic information frees up potential to maximise efficiency as it noticeably lowers the time required for travelling. It also eases the flow of traffic by appropriately distributing and re-routing cars in areas with high traffic volume. Dynamic navigation is also ranked as a high importance factor in terms of fuel and emission reduction.

Dynamic navigation based on real-time traffic data is also very likely to have a positive impact on traffic safety as drivers are better informed about hazardous situations such as a tail of traffic jams, ghost drivers, or the overall high traffic volume.

B Technology Availability

Technology required for enabling dynamic navigation can be split into two parts:
1. The channel for providing the traffic data and 2. The device for receiving and processing this data.

Channels for traffic information:

The Traffic Message Channel (TMC) is a specific application for the FM Radio Data System (RDS). It is used for broadcasting real-time traffic and weather information specifying the relevant locations. In many European countries TMC services are available free of charge for users. In the context of dynamic navigation the RDS/TMC information, more specifically the location, the direction or the duration of a traffic event can then be used to give instant route guidance i.e. alerting the driver of a problem on the planned route and calculating an alternative route to avoid the incident. The alternative route is presented directly to the driver unlike occasional roadside information services such as variable message signs. All TMC receivers use the same list of event codes, while the location database contains a country-specific set of location codes for the entire European road network.

There are also several commercial TMC services in Europe. These services are established through a network of private RDS broadcasters and improved in terms of coverage and content accuracy. Such improvements are possible due to joint use of different sources for traffic information. In Germany for example TMCpro uses a stationary system of 4,000 infra-red detectors and 5,500 inductive loops to measure the velocity of the traffic flow. Additional information comes from cars equipped with a GPS tracking unit, which transmits the vehicle's location and its speed. Official traffic reports from police authorities complete the input for a more accurate and timely information on the traffic situation.

TMCpro and other advanced TMC services are not delivered free of charge and users need to pay a premium when purchasing the navigation device. Dynamic navigation based on TMC relies on the use of location tables since 'traffic events' (such as accidents or congestion) have to be superimposed onto the maps in users' GPS devices by matching the reported location into a location table. The importance of these location tables are expected to decrease as new technology will be able to match traffic events without the current location tables soon.

All current types of TMC services have limitations in the areas of road coverage, content, and frequency of traffic information sent. These shortcomings of TMC services have been used by manufacturers of navigation devices to give additional value to their customers by providing more enhanced traffic information through GSM network. GSM connectivity allows two-way communications between the navigation device and the back-end structure. It also permits sending of a greater amount of data to the devices in shorter intervals. The embedded SIM card also allows a very accurate positioning of the navigation devices and can be used to generate its own floating car data (as described under the part on extended environmental information).

Floating car data does not only play an important role for congestion alerts but also for neutralising reported traffic jam. An example of this is when a specified number of cars equipped with a GSM navigation device drive through a reported traffic jam at normal travelling speed and they deliver proof to a back-end system that this particular traffic jam does not exist anymore. Such information can then be distributed with very short delay to all subscribers of services. Values for typical update cycles like this are below one minute and therefore come close to the RTTI scenario. Dynamic navigation based on GSM network also use TMC and TMCpro data, which is reprocessed, aligned and matched against each other and then distributed to all GSM-navigation devices within a certain area around the traffic incident. This push procedure enhances therefore not only the timeliness but also the relevance of traffic information provided to every individual road user. The service contracts for GSM based dynamic navigation are mostly based on monthly payments.

Devices for traffic information:

The term dynamic navigation is aligned with the introduction of navigation systems that were able to give advice on re-routing based on TMC information. There are basically two different solutions for in-car navigation today: portable navigation devices and in-build navigation systems.
In most cases in-built navigation systems are a part of an entire car entertainment and telematics platform, which includes navigation, telecommunication, media player and other functionalities. The systems are well-integrated in the car's infrastructure and meet high automotive safety standards. Since they are designed as multipurpose devices, no additional screen is needed for the navigation functionality.

With regards to the software, in-built navigation systems can follow overall design patterns, which are then repeated in the entire HMI-infrastructure of a car. The actuality of the software and hardware features set can be however evaluated as on a lower level than as they are on a PND. This is caused by the fact that PNDs follow a much a shorter product life-cycle than the in-built systems. Therefore new technologies are implemented quicker in portable navigation devices. In terms of map material there is also a difference between PNDs and in-built navigation systems, as most in-built systems require the purchase of a relatively expensive CD or DVD for map-updates, which for European map material can cost up to 200 Euros per copy. For PNDs, map updates start at much lower prices and the maps can be downloaded onto the device with the customers' PCs. There is also a higher frequency on releases of new map-material for PNDs.

Another important difference between the two kinds of navigation systems are the purchase prices. Where in-built navigation systems, that inherent several functionalities, can easily cost up to 3500 Euros (starting at around 1100 Euros), PNDs with the same feature set start from even under 100 Euros. Premium PNDs with comprehensive map material and software feature sets as well as large screens and GSM connectivity for enhanced traffic information or LBS (location based services) can cost up to 500 Euros.

In terms of safe incar integration of PNDs there is still under supported, as most PNDs sold today are used with suction cup holders that are placed on the windscreen of the car. These can cause problems in case of an accident and also with regards to the field of view (FoV) or airbag deployment. More findings on this topic can be found in the current final report of the nomadic device forum. However there are several bilateral collaborations between car and PND manufacturers, where PNDs are safely integrated into the car. Such cooperations also allow additional functionalities of a PND such as using the car loudspeakers for voice response or getting access to sensor data of the car. One can also expect that the proportion of mobile phones and mobile internet devices used for dynamic navigation in cars is going to increase in the future as these devices already have GSM connectivity and can also be used for navigation purposes.

C Road and Information Infrastructure Need and Availability

A system that provides traffic information is readily developed and available in some but not all European countries. That is why the quality of traffic data provided and also the cost behind this system needs to be monitored.
Even in countries where TMC services are well integrated, most traffic information is available for motorways only. That is why in an additional future step the extension of services to urban roads should be developed until high-quality traffic information is available for the entire road network.

In terms of information infrastructure there are limitations due to the FM radio network used for TMC information. The transfer rate is limited to 60 bit/s, which approximately equals 10 TMC messages per minute. In combination with the missing reverse channel, this strongly limits the potential of such traffic information network for dynamic navigation. Therefore, great future potential for traffic information networks is linked to the establishment of GSM, GPRS, UMTS or LTE connectivity as they allow extensive two-way data transfers between device and back-end structure.

D Organisation requirements

As PNDs deliver cutting-edge technology in terms of processing traffic information at a fraction of the cost of in-built navigation systems, an interface (NaviFIX) as proposed by the Nomadic Device Forum (NDF) for safe in-car integration of PNDs needs to be promoted.

Other organisation requirements for dynamic navigation are close related those of RTTI:

- Strong support for the development of more advanced networks for data transfer e.g. GSM, GPRS, DAB, LTE.
- Ensuring cross-border functionality and a standardised strategy for implementation of real-time traffic information
- Decision about the extent of the feature set of free TMC services and a overall structure that leave room for provision of commercial services
- Easier access to traffic data of authorities

E Regulatory Requirements / Barriers

As shown under section D European actions are need to be aligned and barriers removed in the areas of:

- Network to be use
- Cross boarder functionality
- Business strategy for commercial traffic services and PPP
- Safe integration of PNDs in cars
- Improvement of traffic information content
- Roaming issues for cellular networks
- Strategy to promote equipment of cars with navigation safe devices for dynamic navigation

F Security

In order to reduce misuse of positioning information and avoid a tracking possibility, special “data only” GSM cards should be used. These GSM cards cannot be used to establish a voice connection and therefore, they do not need to be personalised (assigned to a certain person). Another possibility to improve security is the arrangement of changing ID for the navigation devices. It needs to be investigated if these solutions are efficient enough to ensure system security.

G Business Case / Customer Awareness and Acceptance

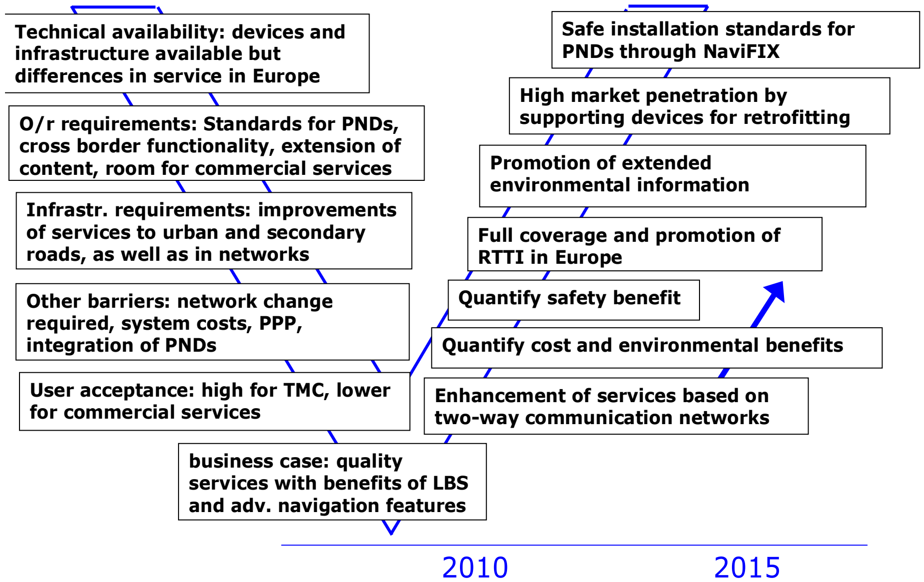
Basic TMC services are delivered in most European countries free of charge (except in France and Great Britain). The applied business case for commercial traffic services against payment arises from a more accurate data provision. Dynamic navigation based on cellular connectivity allows other premium services such as location based services, community services or further advanced traffic information (FCD).

TMC services are widely accepted in Europe. For example almost two out of three navigation systems that are sold in Germany with TMC functionality or at least to provide the possibility to upgrade to this service easily. Further steps on the way to greater customer awareness for the benefits such as reduction of the total time of travel, fuel consumption and reduced emissions due to dynamic navigation. In addition to that a European wide strategy for improving the quality and extent of services provided as well as standards for safe installation of PNDs in cars could also help raising customer awareness for the topic.

H Key Success Factors

Various factors for the success of dynamic navigation can be found. The following are the most important once:

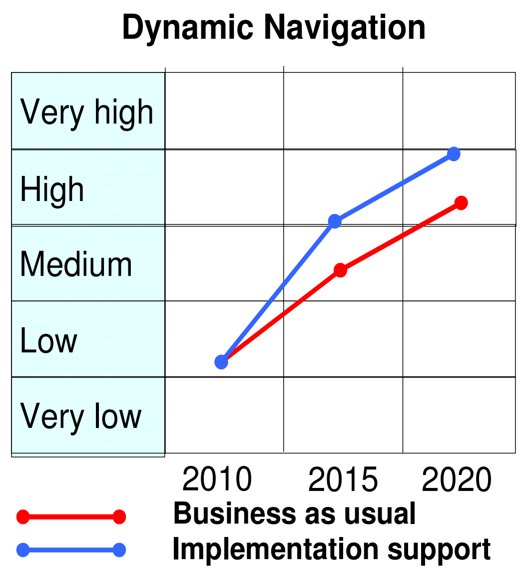
- Improvements of traffic data in terms of accuracy and relevance
- Improvements in the communication infrastructure used for traffic data
- Extension of traffic information services to secondary and urban roads
- Establishment of a basic set of free data throughout Europe, while leaving enough room for commercial service such as advanced traffic information, LBS, and community services
- - Making advanced dynamic navigation affordable and safe, by establishing standards for safe PNDs and also promoting an installation interface (NaviFIX) as shown in the final report of the NDF. This would push the market penetration rate for cars equipped with dynamic navigation functionality dramatically.



According to the V analysis of the implementation of dynamic navigation, the measures to be taken include the following:

- Introduction of basic TMC services free of charge across Europe
- Enhancement of accuracy of travel information and extension of services to secondary roads
- Development of a common strategy to move from a RDS-based network to a more advance, faster network that allows higher amounts of more frequent data and two-way communications in the future (GPRS, GSM, LTE, etc.)
- Raising customer awareness and accelerate market penetration by promoting devices that allow of dynamic navigation
- Provide evidence for the benefit of dynamic navigation with empirical research (for reduction of time travelled, cost savings due to less fuel used, reduced emissions and improved road safety)
- Promotion of safe installation interface for PNDs and safety standards for PNDs, since they deliver latest technology of dynamic navigation at affordable prices to customers.

With the support of these measures, the market penetration of dynamic navigation in new cars in Europe is forecasted as the following up to 2020:



ANNEX 4: MEMBERS OF THE IMPLEMENTATION ROAD MAPS WORKING GROUP

Implementation Road Maps WG - List of members 2006-2009

Name	Organisation
Hans-Jürgen Mäurer	DEKRA
Risto Kulmala	VTT
Jörg Breuer	Daimler
Wolfgang A. Reinhardt	ACEA
Bernhard Labudek	ADAC
Joachim Scholten	BMW
Roland Niggestich	BMVBS
Fritz Bolte	BASt
Juhani Jääskeläinen/Francisco Ferreira	EC DG-INFSO
Brian Knibb	KGP
Erich Bittner/Martin Kretzschmar/Kai Lücke	Bosch
Heinz Friedrichs/Sandra Pastore	Bosch
Eva Boethius/Bengt Hallström	SRA
Oliver Deiters	DEKRA
Sabine Spell	Volkswagen
Alessandro Carrotta/Irina Silva	eSafetySupport
Martin Pichl/Helena Hutarova	Czech Republic
Vincent Blervaque	ERTICO
Catherine Lovell/Chris Ward	UK DfT
Anders Holt	NPRA
Bipin Radia/Willy Maes/Eric Kenis	EC DG-TREN
Antonio Lucas/Enrique Bodí	Univ. of Valencia
Sabine Schattke	VDE
Björn Hedlund	CLEPA
Antonio Marques	ETRA I+D
Walter Hagleitner	ADAS Man.Cons.
Jacob Bangsgaard/Irina Patrascu	FIA Foundation
Gerhard Rollmann	SARA Group
Theo Kamalski	TomTom
Michael Schürdt	Medion