

Fifth Summer School
Intelligent Transport System :
Human Centred Design for Safe and Eco Mobility
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ITS functions and their potential consequences on safety

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Ifsttar

General definition and purpose of Intelligent Transport Systems (ITS)

Resulting from an alliance between computing, telecommunications, vehicles and networks, developed with the purpose to improve transport context:

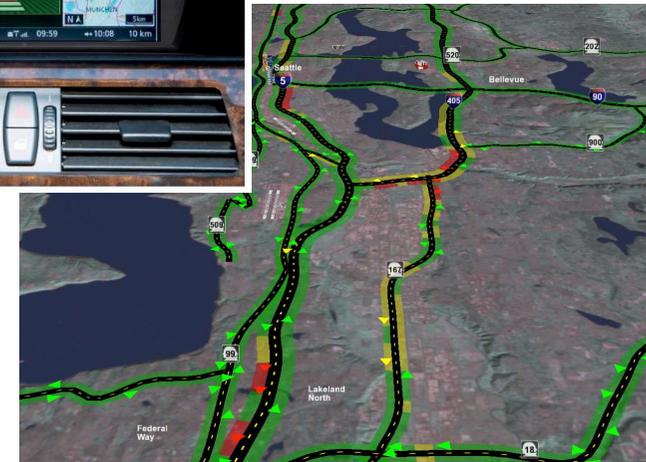
- Controlling mobility
- Reducing nuisance
- Making travel safer in general
- **Improving road safety**



List of services proposed under ISO/TC204/WG1

« Transport information and control systems fundamental services » (1/2)

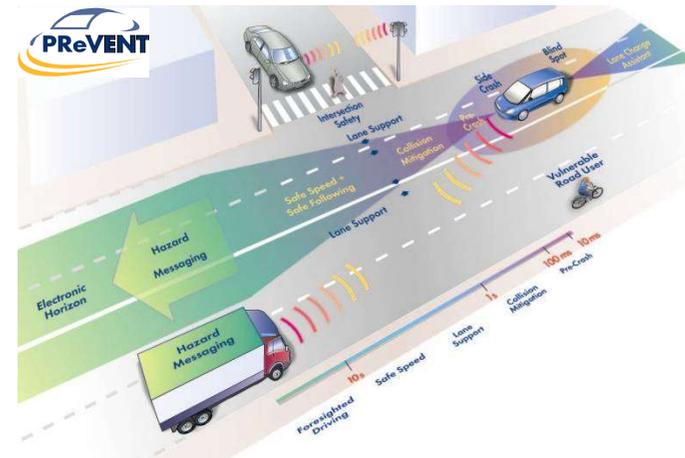
- Pre-trip information
- On-trip driver information
- On-trip public transport information
- Personal information services
- Route guidance & navigation
- Trip survey and data
- Traffic control
- Incident management
- Demand management
- Policing/enforcing traffic regulations
- Infrastructure maintenance management
- Vision enhancement
- Automated vehicle operation
- Longitudinal collision avoidance
- Lateral collision avoidance
- Safety readiness
- Pre-crash restraint deployment



List of services proposed under ISO/TC204/WG1

« Transport information and control systems fundamental services » (2/2)

- Commercial vehicle pre-clearance
- Commercial vehicle administrative processes
- Automated roadside safety inspection
- Commercial vehicle on-board safety monitoring
- Commercial fleet management
- Public transport management
- Demand responsive public transport
- Shared transport management
- Emergency notification and personal security
- Emergency vehicle management
- Hazardous materials & incident notification
- Electronic financial transactions
- Public travel security
- Safety enhancement for vulnerable road users
- Intelligent junctions



Issues of ITS and road safety

- Diversity of available functionalities: e.g.
 - IVIS/OBIS: information for the driver/rider
 - ADAS/ARAS: assistance for the driver/rider
- Consequences on road safety
 - Positive: ITS to support critical situations
 - Negative: Interference linked to the use of ITS



In-vehicle ITS and safe driving support

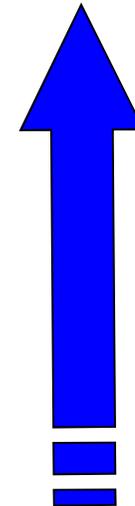
Various Functions

IVIS (In Vehicle Information System): Enhanced driver's perception, decision, type of action

ADAS (Advanced Driver Assistance System): Assist driver to control and to manoeuvre

- Complete control of vehicle (Automatic Highway System)
- Partial control of vehicle functions (steering, stop & go)
- Driver assistance (active pedal)
- **Warning (alert)**
- **Information for comfort (guidance)**

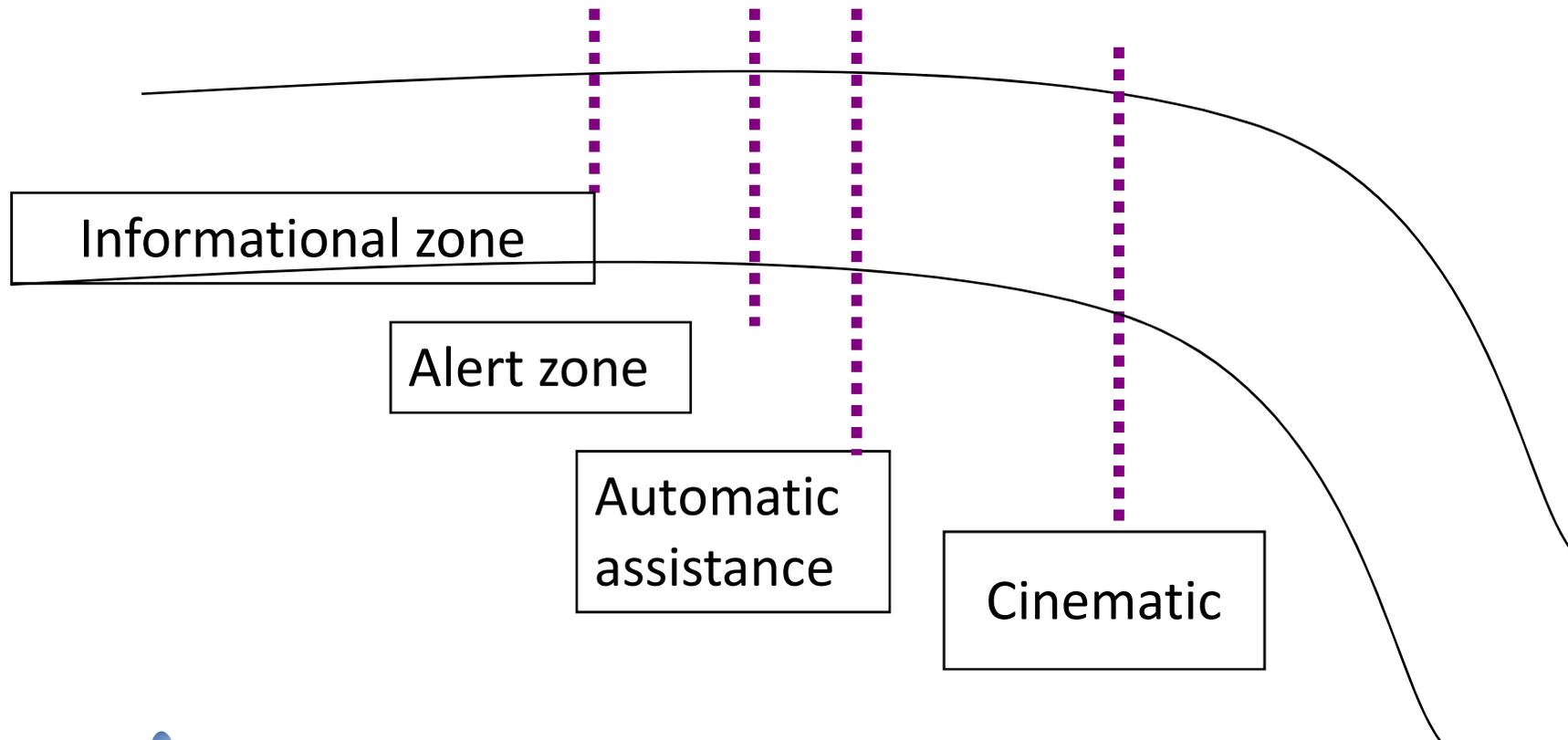
ADAS



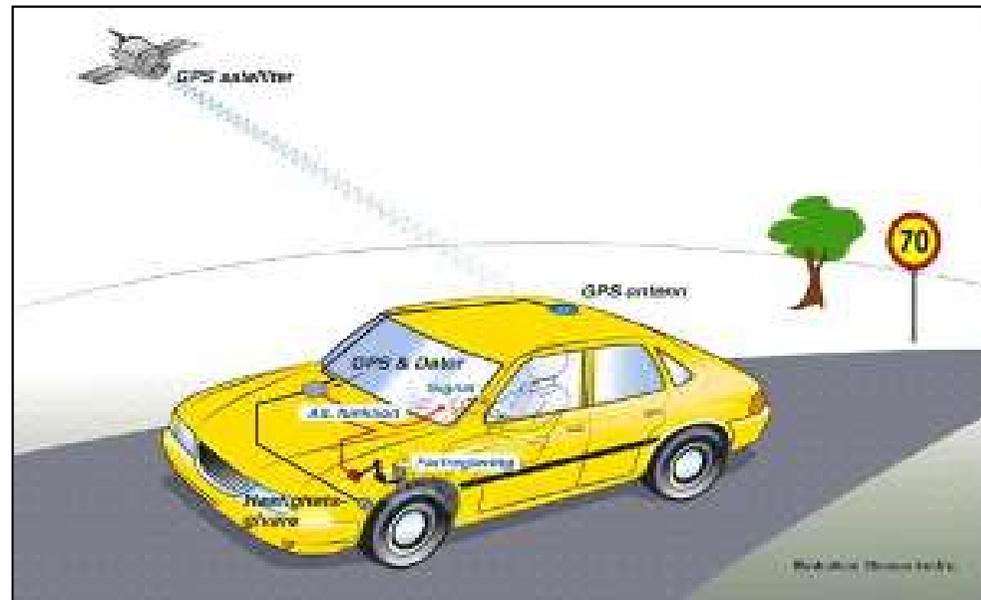
IVIS

In-vehicle ITS and safe driving support

Definition of operational limits for curve warning/assistance

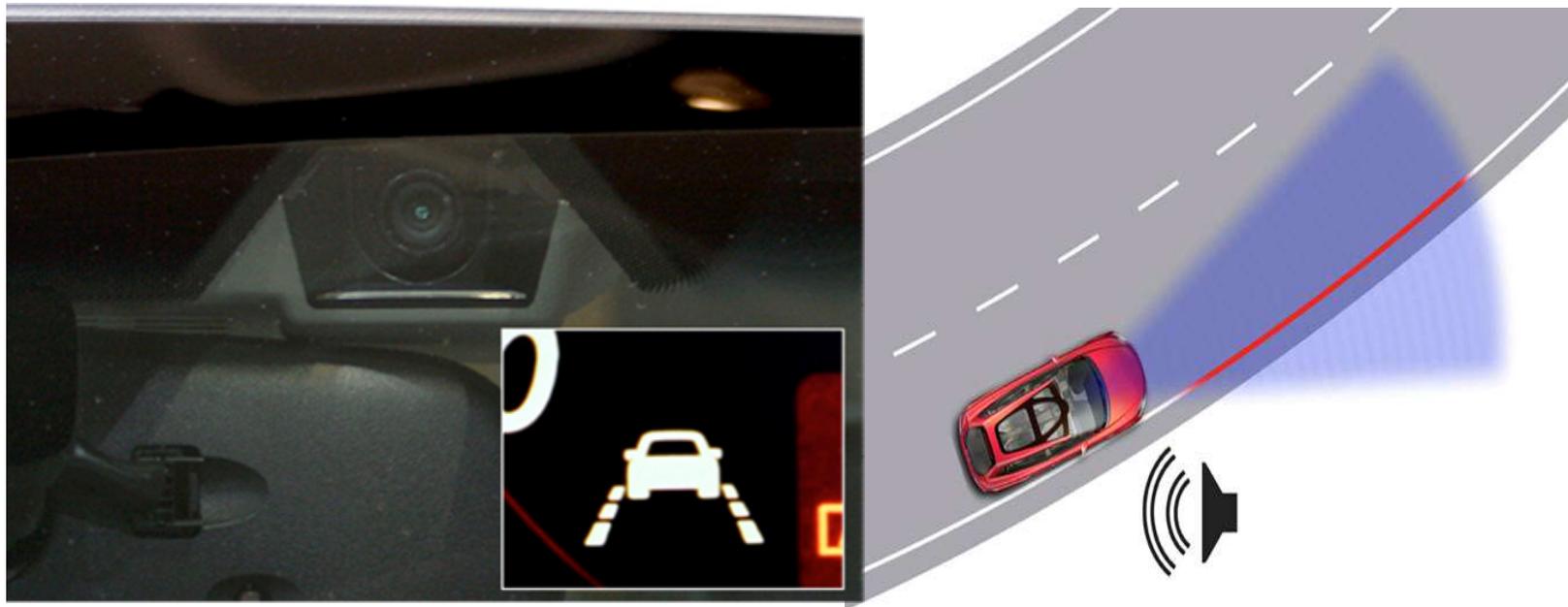


Informative or Automatic speed limit (from IVIS to ADAS)



Intelligent Speed Adaptation

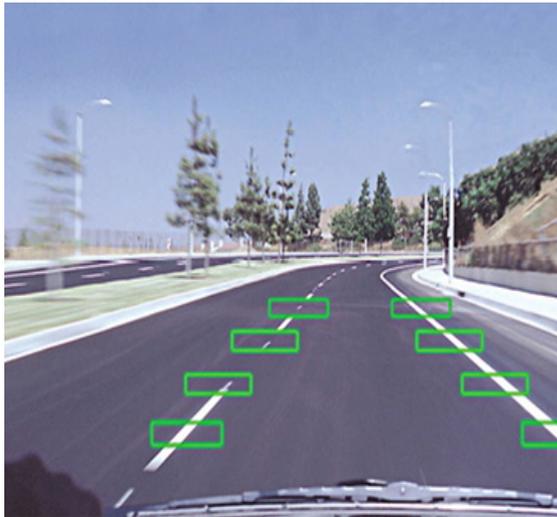
Inform the driver about lane keeping IVIS



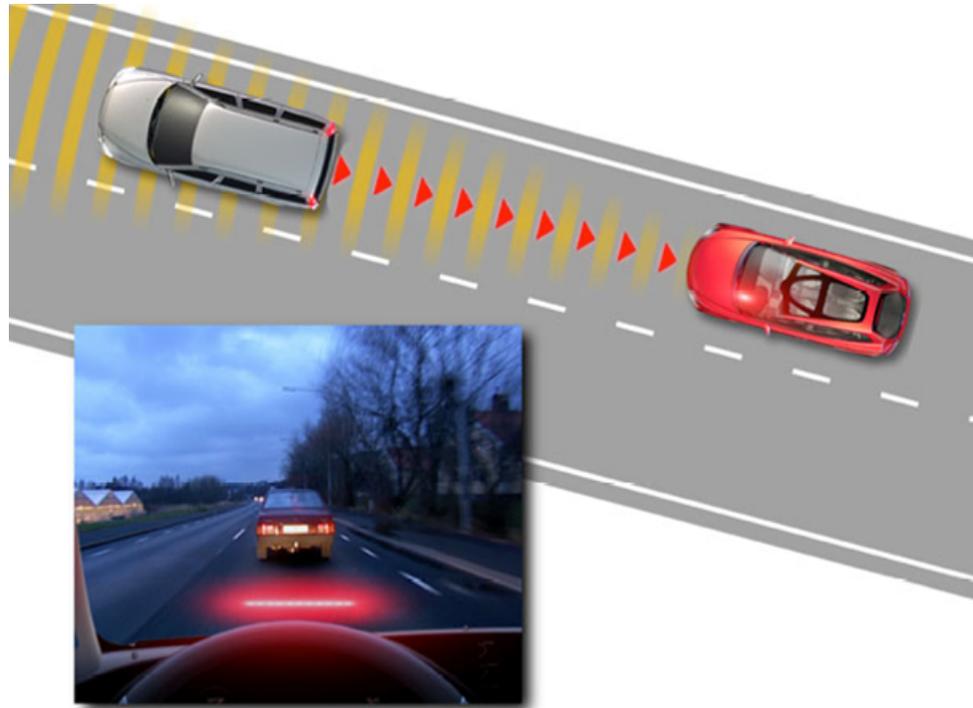
Visual

Auditory

Automatic lane keeping ADAS



Inform the driver about safe distance IVIS



Automatic safe distance ADAS



Guidance and navigation for riders OBIS

- **Powered Two Wheels**



Rear view perception of road events for riders OBIS



- **Vehicle and PTW: camera for rear view**



In-vehicle ITS and safe driving support

Road safety issues



Improvement : a chance to reduce road accidents with innovative assistance such as collision avoidance, vision enhancement, adaptive speed control, road traffic information and weather conditions

Interference : a context to create new critical driving conditions by inducing driver mental workload, attentional sharing, necessity to manage supplementary activities in addition to the driving task such as answering to a phone call, dealing with electronic mail or even, for aid systems, trying to understand visual and auditory messages

In-vehicle ITS and safe driving support

Set of functions proposed by integrated systems, after-market systems and nomadic systems

- **Related to the driving task (IVIS and ADAS): Positive consequences on Road Safety as long as the systems are correctly design**

Example of Guidance Systems: Researches on real road contexts showed that using an integrated systems guiding the driver and giving information on the road traffic decrease the driver's mental workload and improve the anticipation and decision processes.

- **Disconnected with the driving task (electronic mail, hands free phone): High probability of Negative consequences on Road Safety except when the driver is not too much loaded by the driving task**

Example of the Mobile Phone: Researches in epidemiology showed that phoning while driving leads to a supplementary risk of road accident due to driver's distraction.

Positive impact of ITS on safety:

- Enhanced perception
- Increase in situation awareness
- Speed of decision taking



Vehicle to Vehicle & Vehicle to Vulnerable users

Positive impact of ITS on safety

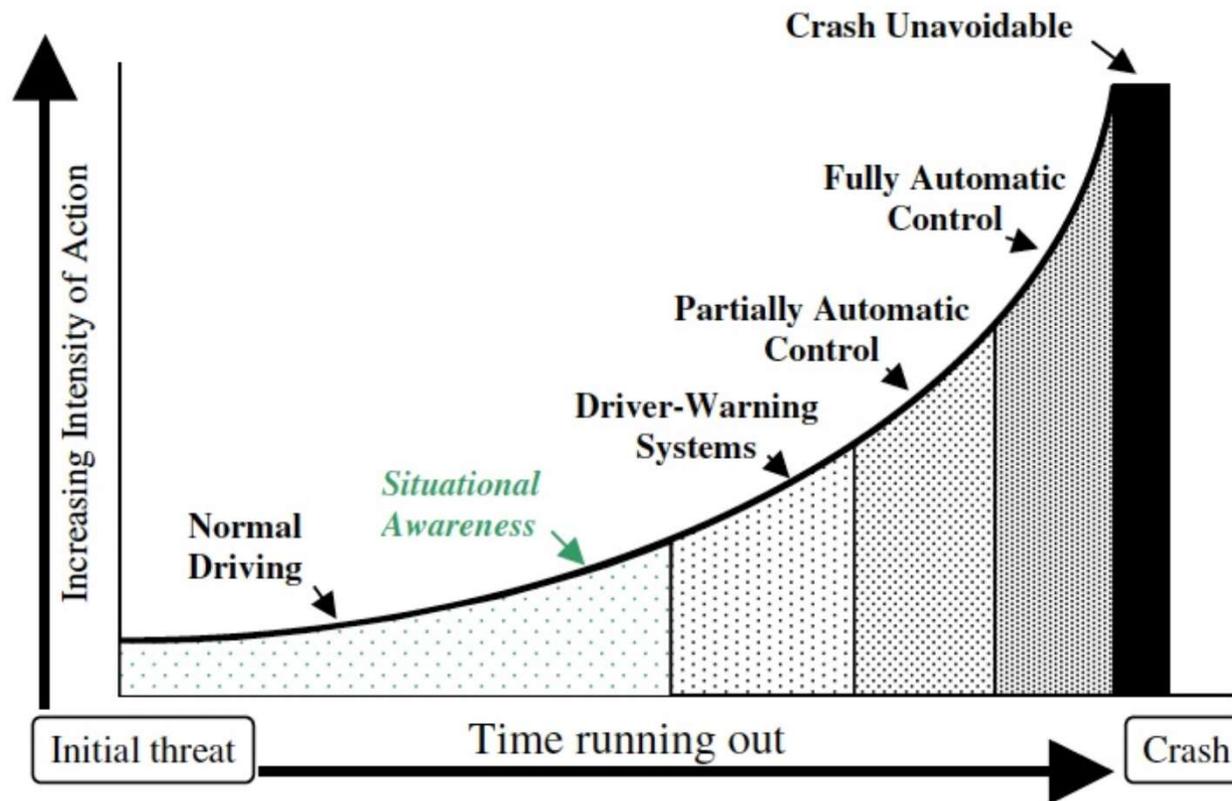
Hierarchical 3-level Model of driving task

Driving task	Stabilization	Level of responsibility	Virtual driver	Response time < Resp. time driver	Intervention	Chassis control systems		
	Guidance		Level of complexity, mental demands		Virtual copilot	Response time > Resp. time driver	Control	Driver assistance systems
							Recommendation	
		Warning						
		Information						
	Planning		Virtual co-driver		Recommendation	Traffic information, navigation systems		
					Information			

Fig. 2: Hierarchical 3-Level Model of Driving Task

Positive impact of ITS on safety

From normal driving to crash



Positive impact of ITS on safety

Accidents in France and Germany



Negative impact of ITS on safety

- Increase workload and attentional demand
- Create distraction



TV receiver



interference with the main driving task

Negative impact of ITS on safety



Driver distraction

- Visual (eyes off the road)
- Manual (hands off wheel)
- Cognitive (mind off driving)
- Auditory (sounds)

Sources of distraction from on-board systems

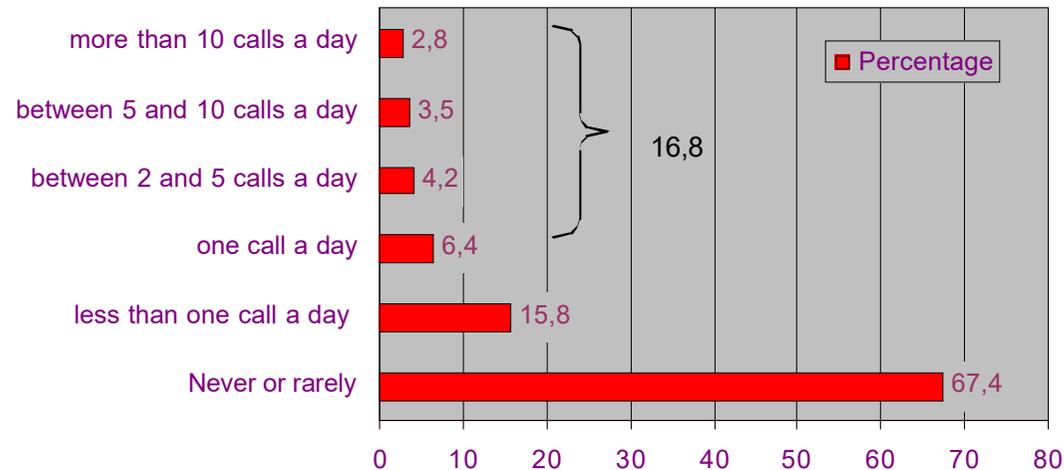
- Wireless communication (mobile phone)
- Navigation system data entry
- Map and other complex visual display
- In-vehicle office tasks (@, PDA, internet)
- Infotainment (DVD)
- Multifunction displays and controls



Negative impact of ITS on safety

Example of a study on the impact of the mobile phone conversation

- 47% of the French population drive a car and use a mobile phone.
- 33% of them said that they could phone during driving at least sometimes.



Frequency of mobile phone use during driving (French survey, 2006)

Issues of ITS safety

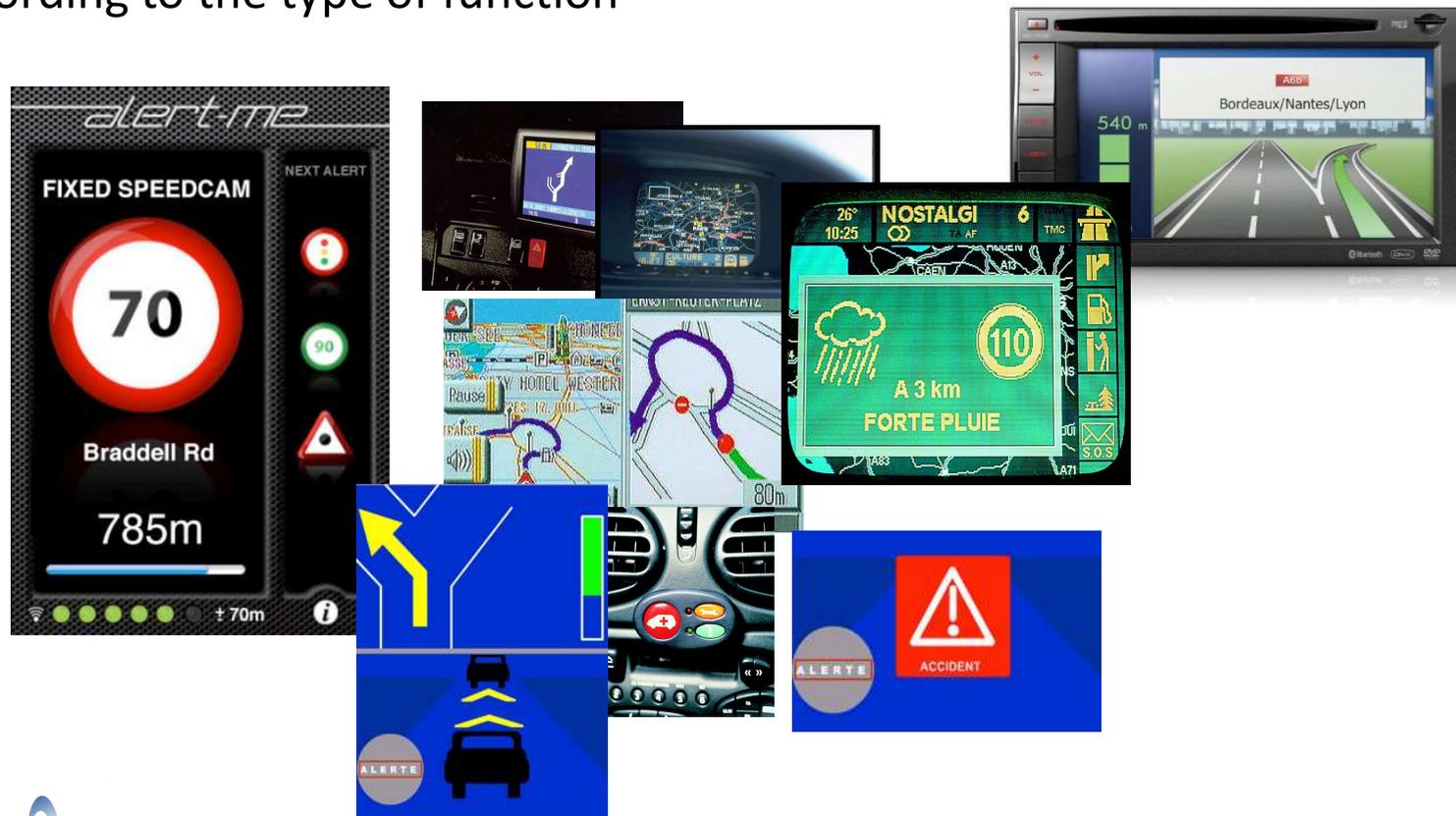


- **System reliability**
Reliability of hardware and software, propensity of mal function and potential to go into a dangerous and/or unanticipated safety mode
- **Overall traffic system**
Aggregate effect on the traffic system as a whole
- **Human Machine Interaction**
Key issues are function allocation, design of the interface and definition of dialogue between the driver and the system

Human centred design approach for ITS

Human Machine Interaction

- **Various Human Machine Interactions:** various designs of the interface according to the type of function



Human Machine Interaction

- *Various Human Machine Interactions* for the same function (ex: guidance)



Bird of view: 3 D map



Classical map: 2 D map

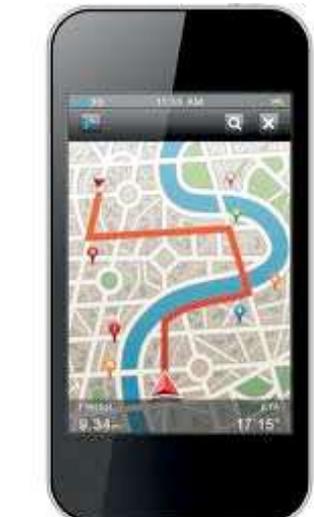


Human Machine Interaction



Various devices

- Integrated systems
- After market
- Nomadic devices



Human Machine Interaction

**A challenge for design and safety
when considering the rider**

Examples of **Head Up Display**, and
of **pictograms** displayed on a **tactile screen**



Human Machine Interaction

**A choice for the commercial companies:
the example of express delivery vehicles**



**ICT
Human
Centred
Design**

Intelligent Cooperative Systems

- Cleaner & safer driving task
- Safety context for vulnerable road users

ICT nomadic services

- Car sharing
- Self service bicycles
- Public transport
- Parking availability & localisation

Driver **Rider** **Cyclist** **Pedestrian**

Eco-driving

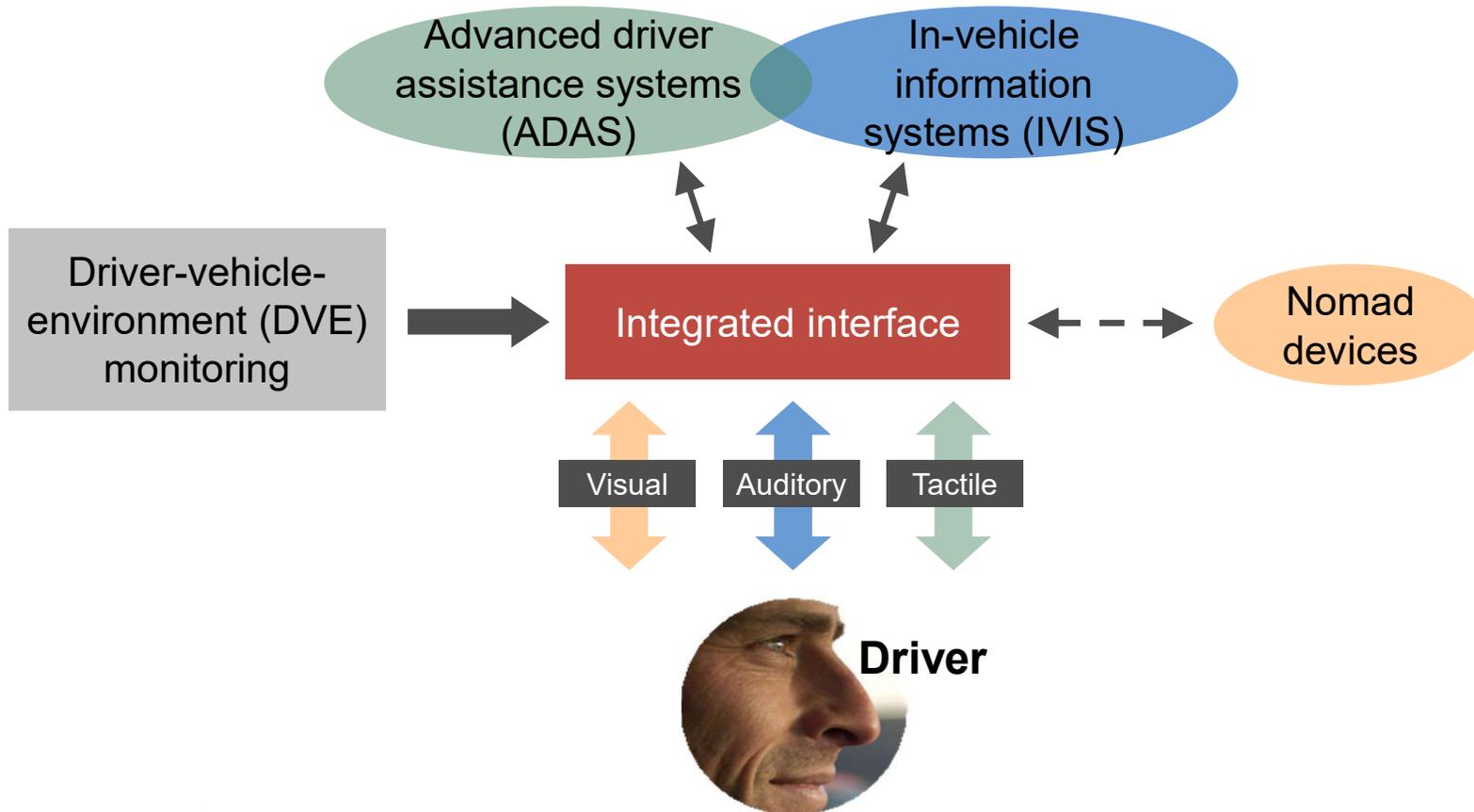
- Training
- HMI design
- e-vehicle
- Car sharing

Towards a sustainable mobility within a resilient road transport system

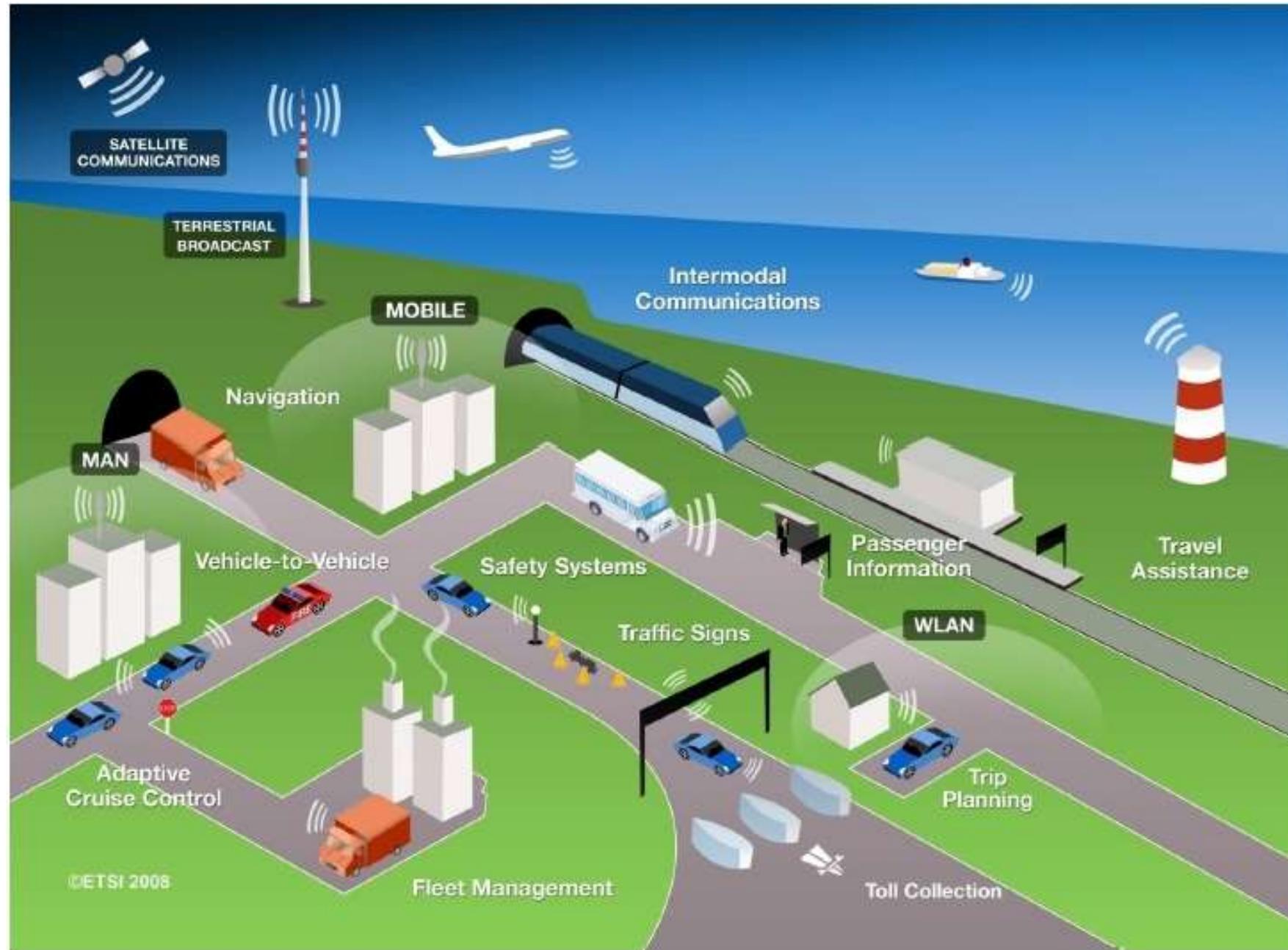
Long term impact of ITS on clean multi-modal mobility

Conclusion

The adaptative integrated driver/rider interface



Cooperative systems and services for all modes of transport

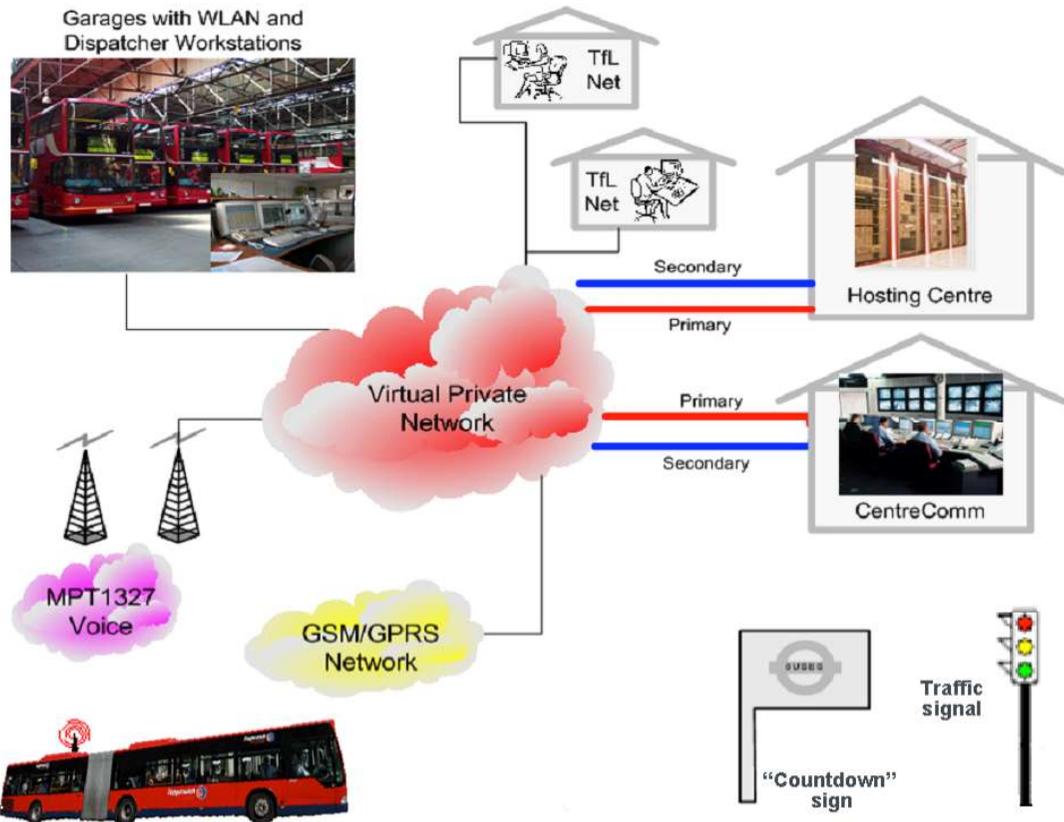


Annexes

**Some examples of ITS
functionalities**

iBus system overview in London

- Bus Service Control
- Passenger Information at Bus Stops
- On Bus Next Stop Signs
- Bus location in an emergency
- Performance Management
- Bus Lane Enforcement
- Traffic Light Priority



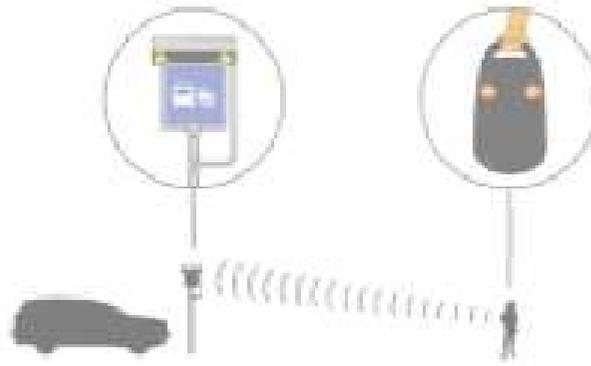
ITS: on-board information for bus driver



Mobile main functions

- Navigation functions (road map, due optimum path, bus localization)
- Stops address and scheduled time to be followed by the bus
- Number of passengers for each stops
- Ticket codes of the reservations
- Audio and video information on the next stop
- On board device status information
- Magnetic card reader for credit card payment
- Viva voce equipment for bus-center communication via GSM

Visibility of children waiting at bus stop



System in order to increase visibility of children waiting at bus stop. It allows automatic detection of pedestrian/children at the bus stop by activating dynamic warning such as flashing lights of the sign.

This concept has been tested by the Swedish National Road Administration and shown reduction of the speed of on-coming vehicles by an average of 13 km/h.

Safety of children while the bus is approaching/leaving

- The Child Safety Alarm System™ is an in the US developed voice alarm system that actually talks to and alerts the children with three distinct, clear and loud voice messages (“Stay back! Stay back, until the bus stops!”, “Look to the driver for a signal to exit or enter the bus. Watch your step!”, “Warning! Stand back! Stand back! This bus is about to move!”)



Services for pedestrians

User Services and Specific User Services defined in "Support for Pedestrians"



Guidance for pedestrians inside building

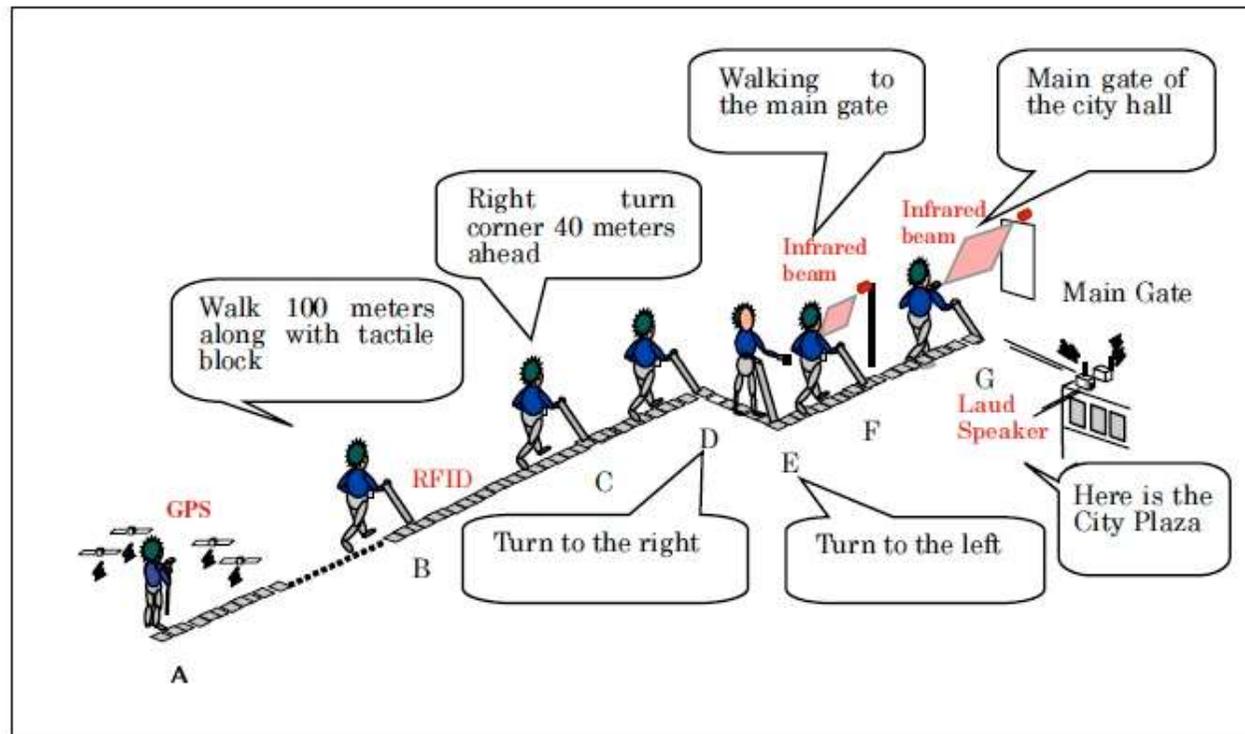


1. Destination setting

2. Route guidance

The image shows a sequence of three screenshots from a mobile phone interface. The first screenshot, under '1. Destination setting', shows a list of destinations: '愛知県庁ビルディング', '市民ホール', '里山遊歩ゾーン', and '会場内サービス施設'. Below the list are buttons for '戻る' (Back) and '次へ' (Next), and a '設定' (Settings) button at the bottom. The second screenshot, under '2. Route guidance', shows a 3D map view with a blue path and a red arrow indicating the current position. Below the map is a message '経路検索を開始します。' (Start route search) and buttons for '戻る' (Back), '次へ' (Next), and '詳細' (Details). The third screenshot shows a 2D map view with a blue path and a red arrow. Below the map is a message '経路案内を開始します。' (Start route guidance) and a '戻る' (Back) button.

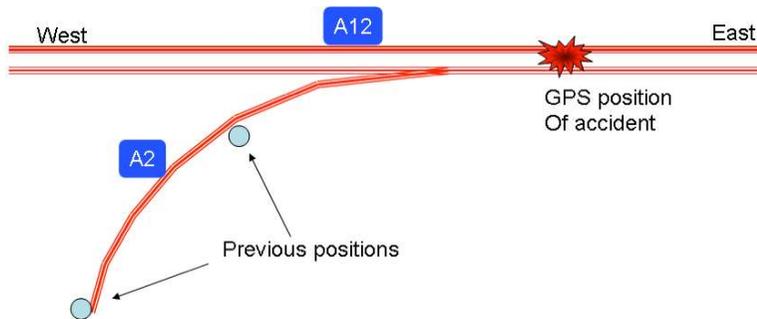
ICT: Guidance for blind pedestrians



ITS applications and road safety

- Automatic incident detection AID, incident management and reduction of secondary accidents
- Reduction of warning delay, even for isolated accidents (ecall)
- Speed control, intelligent speed adaptation (ISA)
- Prevention of accidents due to bad weather conditions
- Control of distances between vehicles (traffic in tunnels)
- Improvement of lateral control and positioning in lane
- Driver monitoring system (drowsiness)
- Improvement of efficiency in guidance and navigation

eCall - e112 automatic call



eCall automates the first step by immediately passing over the exact location of the accident by means of GPS. This position and the previous known positions give the possibility to find out on which side of the road the accident took place. Software are able to calculate the driving direction of the vehicle. GPS not grant accuracy within a few meters, so the previous known points are crucial. The side of the road (highway) is important in determining from which side the emergency vehicles should approach the accident.



Specific care for dangerous goods

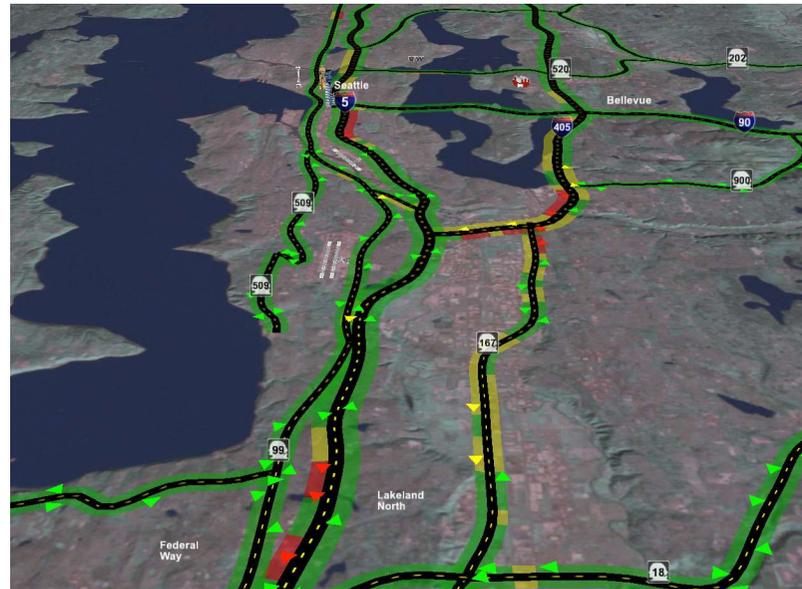
Guidance and navigation

- **Vehicle**



Traffic management

Real time information



Three-dimensional representation of traffic conditions in Seattle, WA

Weather conditions



Detection of pedestrians at night or under degraded conditions



ADAS

Automatic safety functions

- PreCrash
- Automatic emergency braking
- Collision avoidance



ADAS

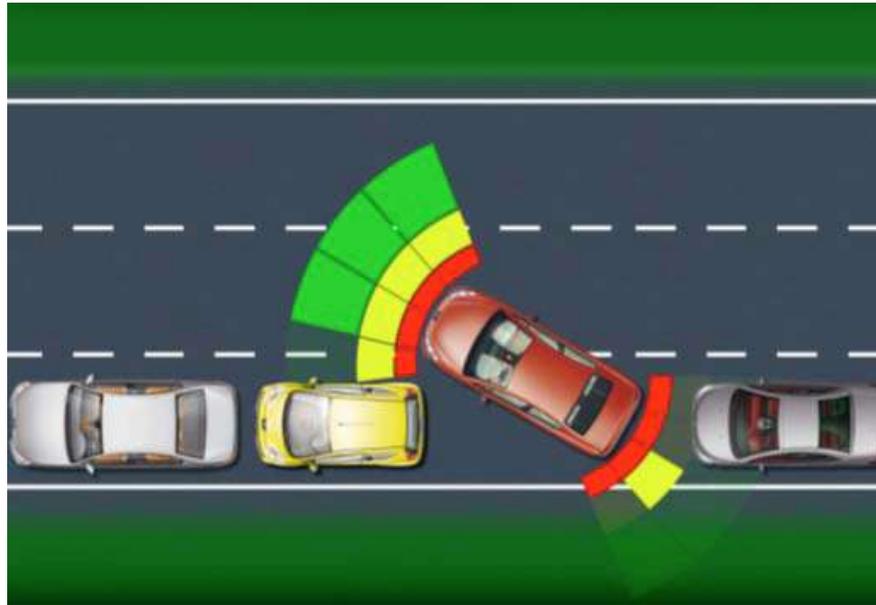
Normal driving functions

- Adaptive cruise control ACC
- Adaptive cruise control Stop & Go
- Adaptive frontlight system
- Night vision



ADAS

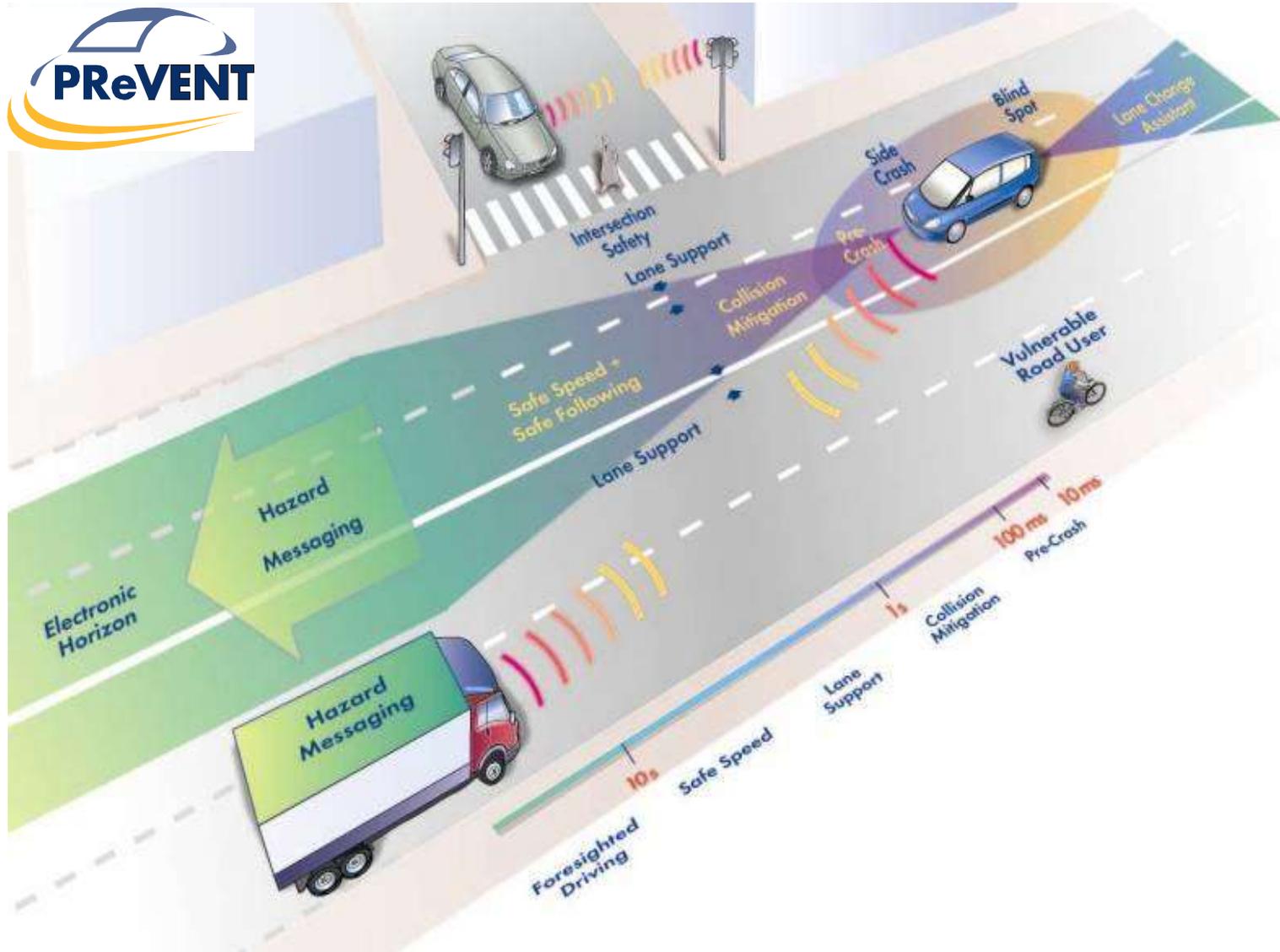
Comfort functions



Parking assistance

ADAS Major Advantages

- Enhancement of road safety. Improved provision of information to the driver assisting in better decision making or improving driving in difficult and/or complex situations.
- Contribution to environmental protection. This is an indirect benefit, i.e. deriving from the reduced traffic congestion due to improved provision of information to the driver.
- Benefit in time and cost due to improved provision of information in real-time.

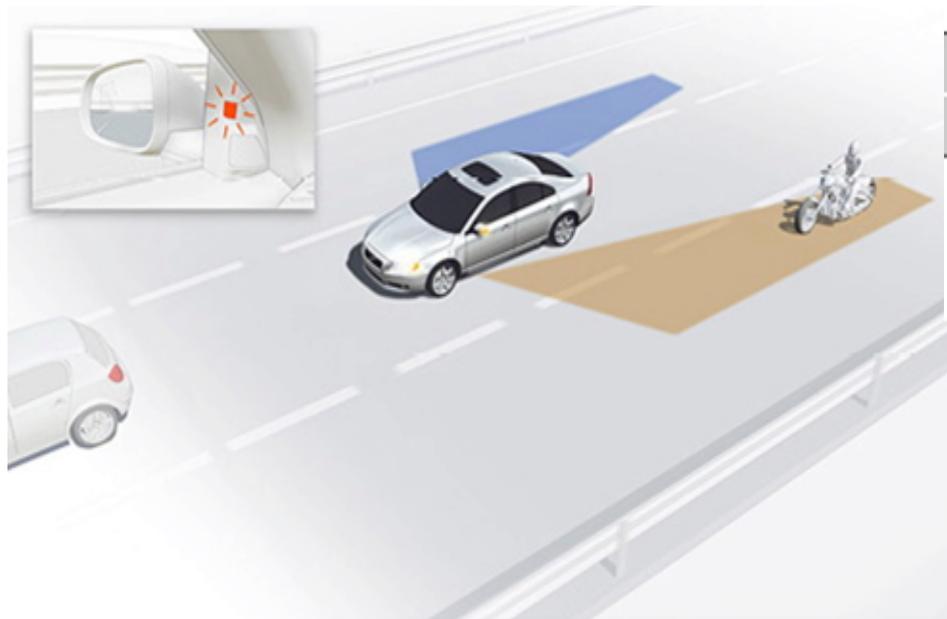


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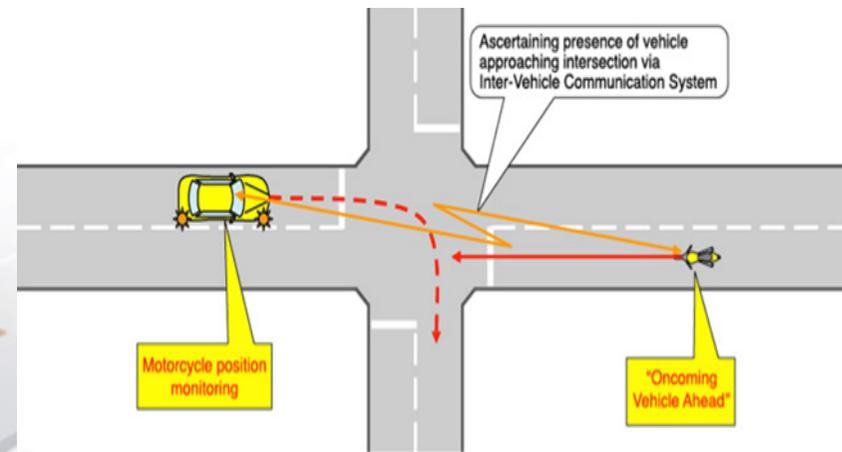
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Enhanced perception for anticipation of critical situations



BLIS Blindspot Information System



Vision of blind view angle and vulnerable users