Focus ome 17

FORESIGHT

Summary of Results
Foresight Observatory for International Markets

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The Future of Mobility

Key ideas

1. Information and communication technologies (ICTs) are currently penetrating practically all business verticals. In the transport sector, the deployment of ICTs and intelligent vehicle safety systems (IVSS) in Europe has involved developing the sensing capabilities of vehicles and traffic monitoring systems to perceive anomalies and hazards in the environment and to improve the fluency of traffic for lower costs and a cleaner environment

2. There are two main application areas in improved sustainable mobility under development and in use to an increasing degree. They are advanced driver assistance systems (ADAS) and cooperative driving systems.

3. What is now taking place is that IT and vehicles are converging so that cars have become a form of traffic infrastructure in that they act as both sensors and communication devices. This will open up a new era in mobility of people and goods. We are entering the world of cooperative traffic.

4. Future traffic systems need to make use of vehicle position and wireless communication to enhance mobility by means of rich information on the status of the traffic system and travellers' needs (Figure 9).

Introduction

In recent decades, transport systems have witnessed strong growth in building infrastructure, continuously increasing traffic exposure, non-optimised transport management systems and the dominance of combustion-engine technology, resulting in a huge number of traffic accidents and harmful emissions.

In the transport sector, high technology has mainly meant more effective and safer motor vehicles that satisfy the needs of more segmented populations of consumers.

Although motor vehicles have also become more fuel efficient over the years, the enhanced economy has been outperformed by the industry itself when introducing heavier and higher-performance vehicles, and above all, the rapid growth of the motorised population in emerging economies.

In the European Union alone, traffic congestion some years ago had a price tag of €50 billion per year or 0.5% of E.U. GDP, and by 2010 this figure is forecasted to be about 1% of E.U. GDP. The number of cars per one thousand capita has increased from 232 in 1975 to close to 500 today. The total traffic exposure of road vehicles has tripled in the last 30 years and, in the last decade, the volume of road freight has increased by 35%,

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which has contributed to 7,500 km, i.e. 10% of the network being affected by traffic jams daily.

Except for vehicle technology, the traffic sector has remained a low-tech area, especially in the way consumers are supported in their daily travel, choice of travel mode and traffic operations as a whole.

Information and communication technologies (ICTs) are currently penetrating practically all business verticals. In the transport sector, the deployment of ICTs and intelligent vehicle safety systems (IVSS) in Europe has been the era of developing the sensing capabilities of vehicles and traffic monitoring systems to perceive anomalies and hazards in the environment and improve the fluency of traffic for lower costs and a cleaner environment. The aim has been to develop applications for driver assistance and systems for the road authorities to help with maintenance and traffic management operations. The trend has been to develop methodologies for using sensor data fusion to provide as full of an understanding of the environment as possible.

The problem is that enhanced sensing technologies have been used mainly for more stand-alone intelligent vehicles and to a lesser degree to support the whole traffic system. The beneficiaries have been a small proportion of premium car segment drivers.

Brief Review of Key Applications

In terms of improved sustainable mobility, there are two main application areas under development and in use to an increasing degree.

They are:

1. Advanced driver assistance systems (ADAS)

2. Cooperative driving systems

Advanced Driver Assistance Systems (ADAS)

An advanced driver assistance system (ADAS) is a system capable of informing a driver of his/her status relative to traffic/infrastructure, provide feedback and assist the driver temporarily in a driving task to avoid a harmful event or an accident. It also increases comfort and relieves driving stress.

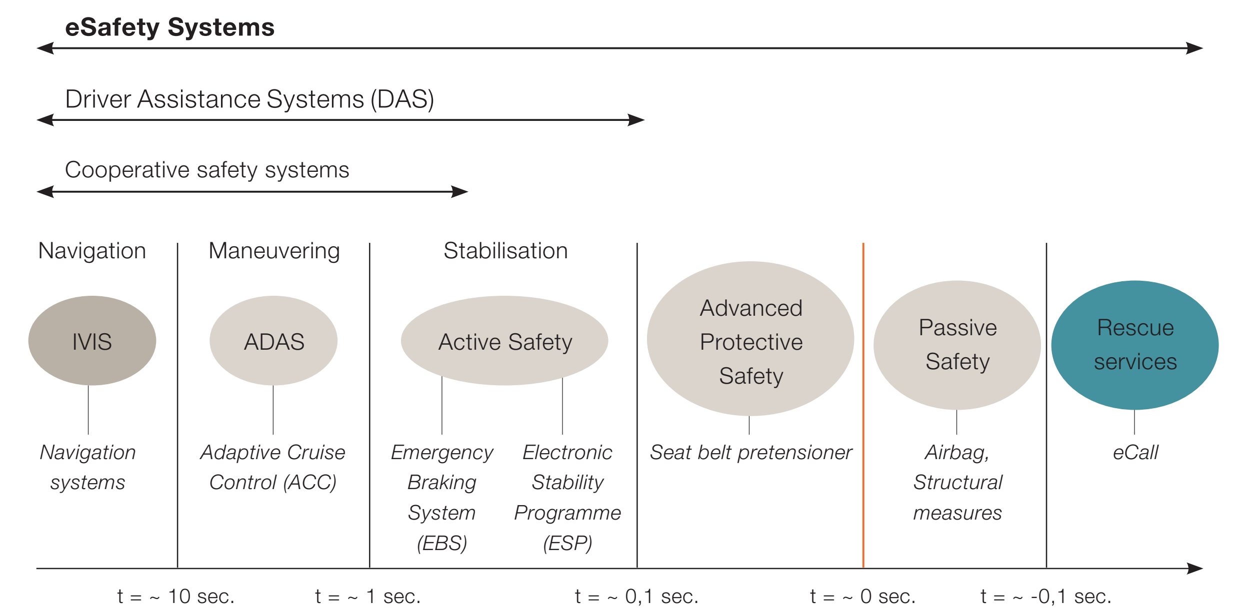
Vehicles have been equipped with systems to facilitate driving and assistance functions for a long time (Figure 8). One of the first examples included electronically controlled synchronised transmission and automatic transmission that, in principle, also reduced the driver's mental workload. The same applies to the antilock braking system (ABS) and even more to the electronic stability programme (ESP). But when can we start speaking of advanced assistance systems? One thing they have in common with early assistance systems is that they lack a human machine interface (HMI) that informs drivers of the status of the system. This is not the case with ESP, for example. The existence of HMI implies that a driver needs to be aware of the system status, since the system may perform actions without the driver being totally in control and may intervene in driving without the driver always being aware of it. A distinctive feature of ADAS systems such as adaptive cruise control (ACC), the lane departure warning (LDW) and the emergency braking system (EBS) is the use of so-called environmental sensors that look outside the vehicle.

Cooperative Driving Systems

The idea of cooperative traffic and cooperation within a transport system originates from the concept of cooperative driving supporting the concept of automated highways, where vehicles are receiving input signals from the road environment, either from the road surface or the road side. The first documented ideas of an automated highway were presented in 1960 by General Motors. In their vision, the car's front wheels were automatically positioned by responding to signals picked up by tuned coils mounted on the front of the car.

Today, the aim of cooperative driving solutions is to support foresighted driving and early detection of hazards. This is done by means of wireless communication-based systems that extend the driver's field of view and warn of potentially dangerous situations ahead. Consequently, the aim of these approaches is to provide drivers with the opportunity to adapt

Figure 1: Vehicle safety systems and ADAS.



IVIS = In-vegicle Information Systems, ADAS = Advanced Driver Assistance Systems

vehicle speed early on and also increase the following distance between vehicles, leading to higher situational awareness of unforeseen dangers.

The main application areas are expected to be as follows:

- Traffic information exchange between vehicles and background systems.
- Traffic management to use the road network capacity to its full extent and harmonise traffic flow.
- Holistic demand management.
- Early hazard-warning system.
- Driver support in merging traffic.
- Platoon driving.

In an even more distant future, cooperative systems may be available for multiple vehicles to help facilitate traffic flow in intersection scenarios. Initial studies in this area have already been conducted.

The cooperative driving concept in Europe was first promoted and addressed in the EURECA project of the EC PROMETHEUS Programme (1987-1994), whose activities focused on bi-directional roadside-vehicle communication and then vehicle-to-vehicle (V2V) communication studies. Ever since, the focus of the European automotive industry has been on stand-alone vehicle safety systems such as ESP, launched by Bosch in 1995, and then different ADAS applications starting with adaptive cruise control (ACC) in 2000. Meanwhile in United States and Japan, activities on cooperative driving continued. A few years ago, after realising the need for earlier driver support than ADAS could provide, OEMs and suppliers “rediscovered” the cooperative driving concept, as reflected in Call 6 FP and today, in Call 7 FP.

In Japan and South Korea, a broad range of cooperative systems has been tested, even though our information of them in Europe is scant. Examples include operative platooning and intersection cooperative systems.

Today, common standards for V2V and vehicle-to-infrastructure (V2I) communication in Europe are under preparation by the ETSI Technical Committee ITS and the Car2Car Communication Consortium (C2C-CC), which was established to promote the idea of common European standards for C2X communication and which has been instrumental in initiating them. The C2C-CC is a non-profit organisation created by European vehicle manufacturers and is open to suppliers, research organisations and other partners. The Car2Car Communication Consortium is dedicated to the objective of further increasing road traffic safety and efficiency by means of inter-vehicle communications.

Some Key Trends

Advances in communication technology, the increasing use of electronics in vehicles, civilian applications in positioning technology and the wider uptake of social media all together serve as enabling technologies for totally new mobility services and concepts.

Furthermore, what is now taking place is that IT and vehicles are converging in that cars are merging into the traffic infrastructure by acting as sensors and communication devices. This will open up a new era in mobility of people and goods. We are entering the world of cooperative traffic.

While cooperative driving is making use of data provided by vehicles sensor systems and infrastructure data-collection systems, the concept of cooperative traffic takes a more holistic view of traffic. Cooperative traffic systems make use of data-led operations starting with data collection by transforming it into information and sharing the information at all levels of travel and transport decision making.

This means we have to understand the transport system as a stratified entity of decision making, where the quality and quantity of travelling and transporting are influenced by societal and individual values and include even a single manoeuvre at the wheel. All these levels can be regulated and supported by timely and rich information on travel costs, impacts and choices, as well as information influencing the situational awareness of a driver on the road. The cooperative aspect is embedded in the capability of different actors either passively or actively to acquire data and share it with other parts and players of the traffic system.

Elementary forms of cooperative traffic are represented today by various traffic management systems and sub-systems techniques employing variable message signs (VMS), which have been widely used for the past twenty years on European roads. The main purpose of traffic management systems has been to improve the efficiency and safety of the road network by harmonising traffic flows and regulating individual driver behaviour. The following types of traffic management sub-systems have been deployed:

- Speed control / section traffic control (traffic-related or weather-related)
- Incident management
- Hazard warning / Congestion warning / Queue warning
- Ramp control
- Network traffic control, including rerouting
- Lane control
- Reversible lane control
- Tunnel traffic control
- Bridge traffic control

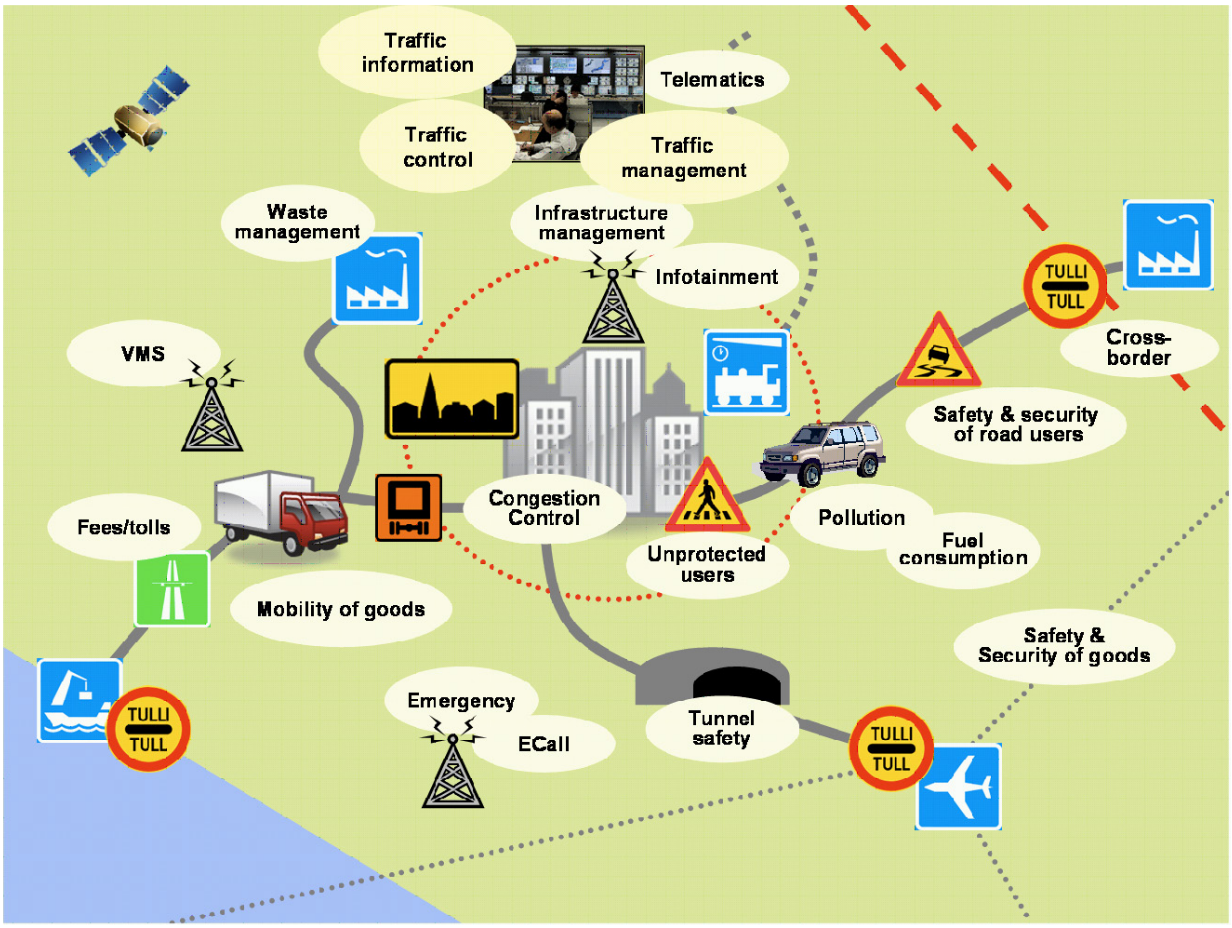
Prospects

Future traffic systems need to make use of vehicle position and wireless communication to enhance mobility by means of rich information on traffic system status and traveller needs (Figure 9).

In the future, cooperative traffic systems should meet the requirements of all users, alleviate the problems of today's road traffic and offer new solutions such as:

- Efficient mobility of goods in all environments, including urban environments as well as border traffic between different countries. This requires compatible logistics information systems, developed navigation systems, real-time routing, electronic fee collection, etc.
- Safety and security of freight and transport, including surveillance and tracking of goods, transport of hazardous goods, sensors in the infrastructure and the car, ADAS (adaptive driver assistance system), ACC (automatic cruise con-

Figure 2: Cooperative Traffic ICTs that enhance mobility: examples of different levels of applications and services.



trol), in-car networking and systems for making night-time driving safer.

- Providing context-aware information to all road users, including information about weather and road conditions, traffic disorders and commercial and travel information.

- Safety and security systems for private road users, such as ACC, ADAS, systems to observe driver behaviour and alertness, context-aware and driver-profile observation warnings and information, parking aids, sensors in the car and infrastructure, vehicle-to-vehicle, vehicle-to-infrastructure and in-car communication, and innovations for vulnerable road users.

- Infotainment and office applications.

- Multimodal travelling services that aim to increase the use of public transport.

In the area of cooperative traffic ICTs, there are several stakeholders with direct and indirect effects on global systems (Figure 10). From the services viewpoint, the value chain starts from service creation and provision, which are integrated by service aggregation actors. The infrastructure plays an important role in the value chain, since road, traffic and communication infrastructure is the backbone of cooperative traffic. The public authorities are responsible for road infrastructure and (telecom) network operators are responsible for communication networks. OEM terminal and vehicle manufacturers, with their league of tier-1 suppliers, provide the common factor for the driver, i.e. consumer services, consumer devices (access terminal) and the car (vehicle).

Finally, it can be concluded that totally new kinds of businesses may emerge from this development. The situation is not always without problems, however. When the service chain involves several players and phases, the question is "Where is the business case?" Traffic services could be based on information broker/provisioning by a service operator, which links end users to several service providers (Figure 4).

Figure 3: Stakeholders in the cooperative traffic ICT value chain.

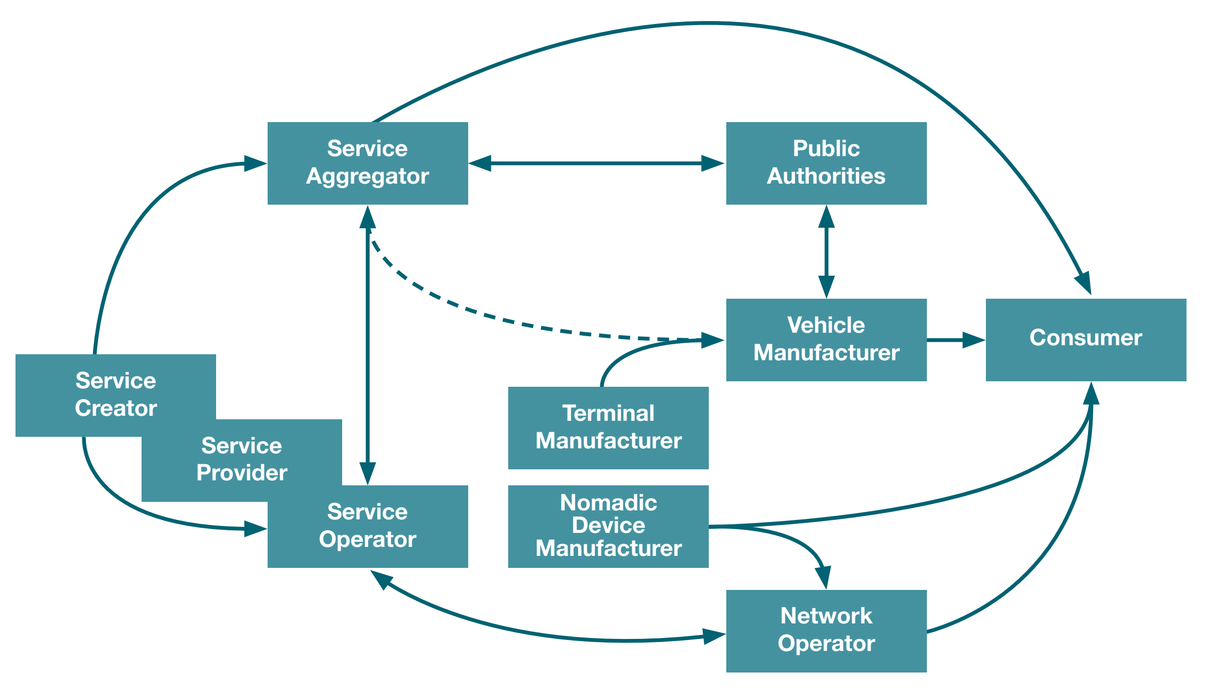
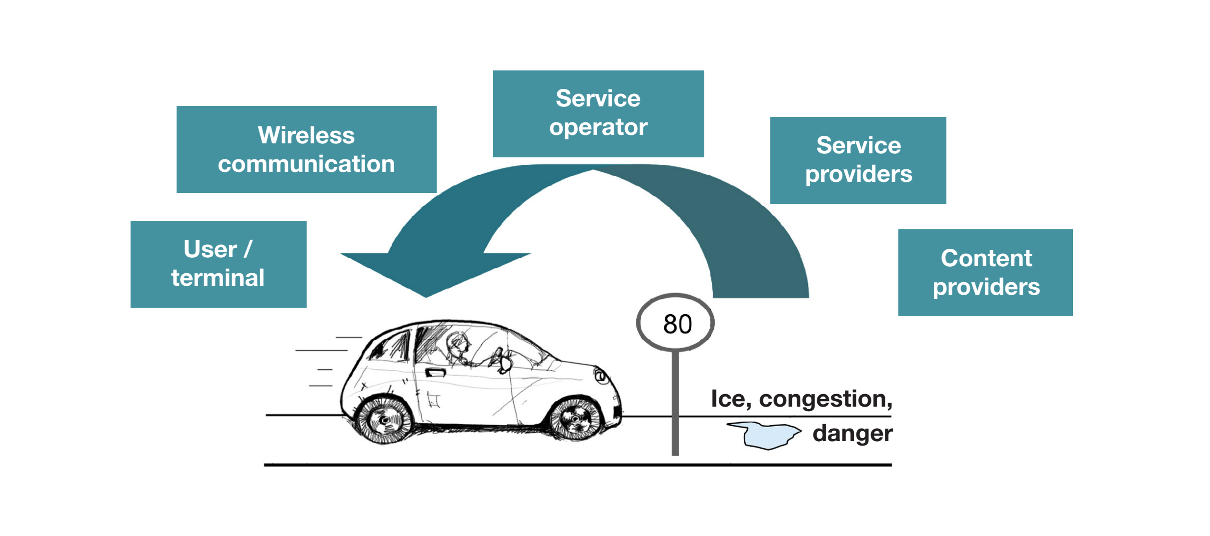


Figure 4: Service provision process chain.



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