Automotive trends in cooperative mobility

Integrated, intelligent and communication systems, the highway forward

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Sustainable mobility

We are mobile. We are traveling more and more. We have more and more cars. We are transporting more and more goods. Even by expanding infrastructures, we cannot keep up with the increasing demand. Besides that we have set challenging targets with respect to safety and environmental protection. The increasing traffic growth and challenging targets require an innovative and broad approach in order to keep all of us mobile.

Zero-X

The growth of mobility itself is already challenging, additional long term targets make it even more challenging. As an ultimate goal, we want to reach Zero-x, which refers to no accidents (no fatalities around 2050), no congestion and no emission.

Next generation solutions

Over the last decades, Traffic and Automotive have developed from different perspective solutions for these challenges. Now the time has come to connect the two worlds, Traffic and Automotive, in order to make significant steps towards the Zero-X targets.

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Current situation

Main drivers

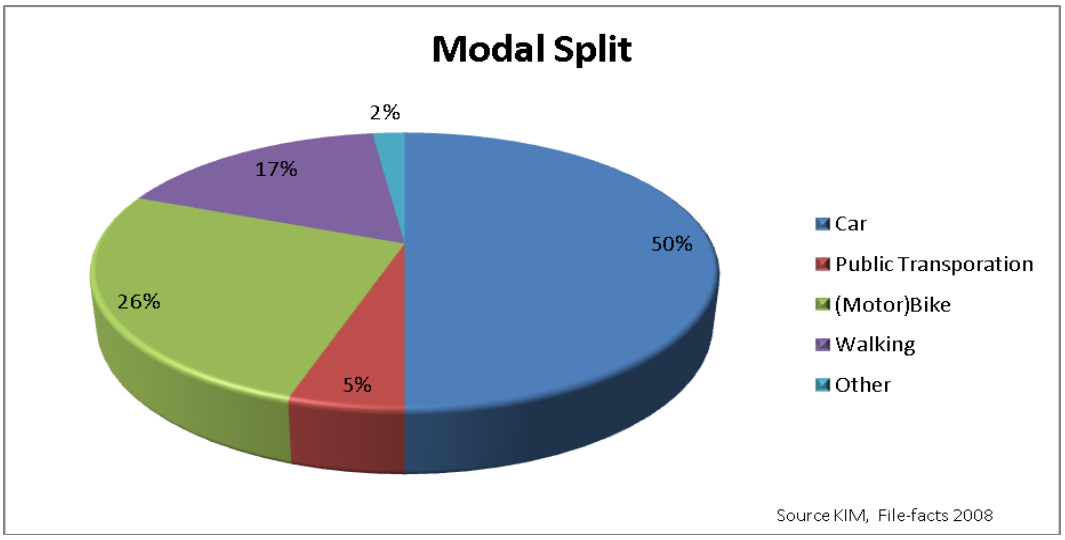
Why should we improve our vehicles and infrastructures?

- Fatalities: 39,000 per year fatalities in Europe. Yes, correct thirty-nine-thousand deaths per year! Total number of injuries is 1.2 million per year in Europe.
- Congestion cost: tens of billions Euros losses per year (The Dutch losses only are already estimated 3.5 billion Euros per year).
- Emission: In the Netherlands, traffic is responsible for 21% of the total CO_2 emissions and 62% of the NO_x.

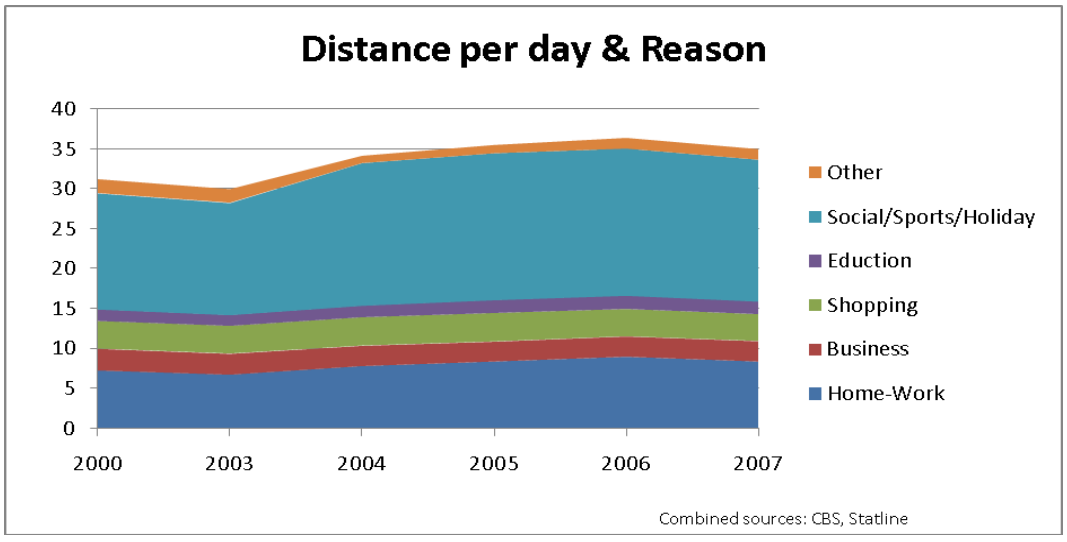
General facts

Let's try to understand mobility first. What is the size? What are the costs and how can we breakdown mobility? The figure below shows the general numbers.

This chapter, analyzing the *current situation* is based on Dutch statistics.



In 2008 the Dutch citizens traveled almost 200 billion kilometers, compared to 1995 an increase of 13%. Most kilometers are traveled by car. Typically we travel 3 trips which are 35 km in total per day. The figure indicates the reasons for traveling.



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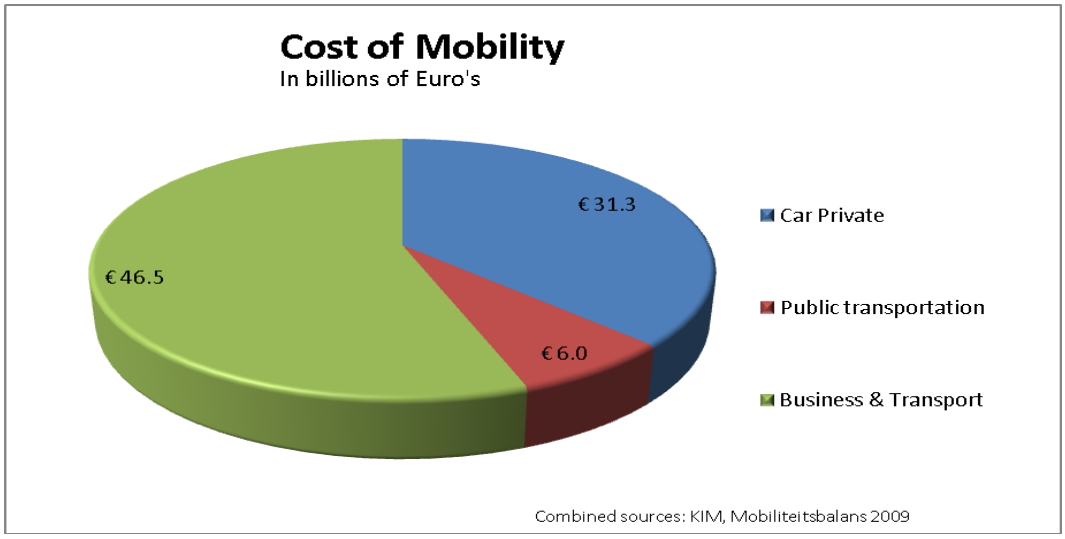
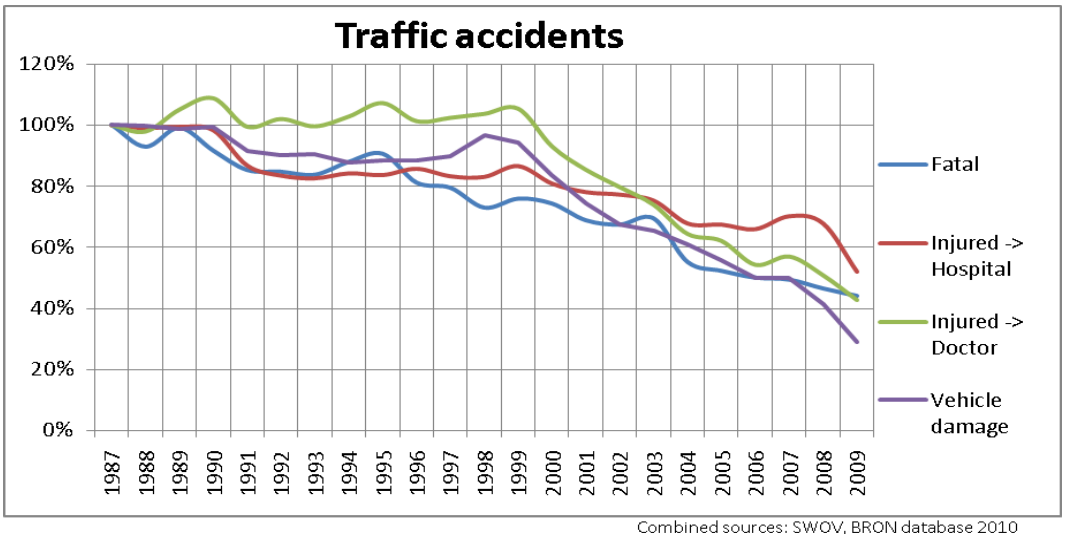
Mobility costs are equal to 11% of the GDP. Besides the cost shown by the figure above, there are the indirect costs like taxes and insurance (estimated around 6.5 billion Euros per year) as well.



Fatalities

In the fatalities trends we see a clear positive trend, some figures are even ahead of the targets set by the Dutch government.



The reduction in accidents is a result of:

- Automotive safety improvements (safety-belts, ABS, ESP, Airbags, specific mirrors for trucks, etc.)
- Traffic improvements like 30 and 60km/h limitations, additional high- and motorways, roundabouts and cycle roads.
- Regulation and education

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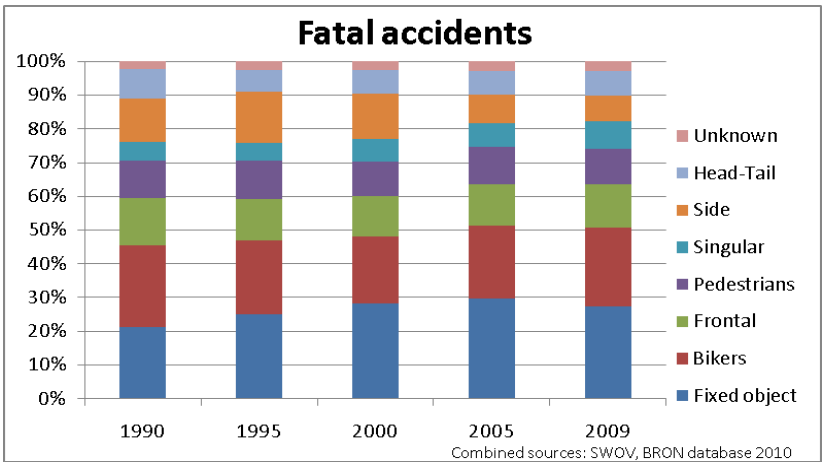
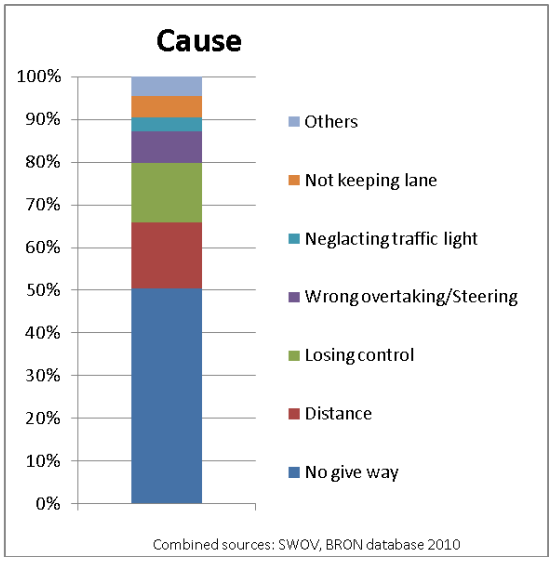
In order to reduce accidents and injuries, it is important to understand the traffic accidents in more details. Find in the picture below the main reasons for the fatal accidents. Note that the drivers and passengers in the cars are protected relative well compared to bikers and pedestrians. In 55% of the cases a “weak road user” is involved. Also visible is the reduction in side impact accidents as a result of the automotive safety solutions in combination with traffic solutions (roundabouts).

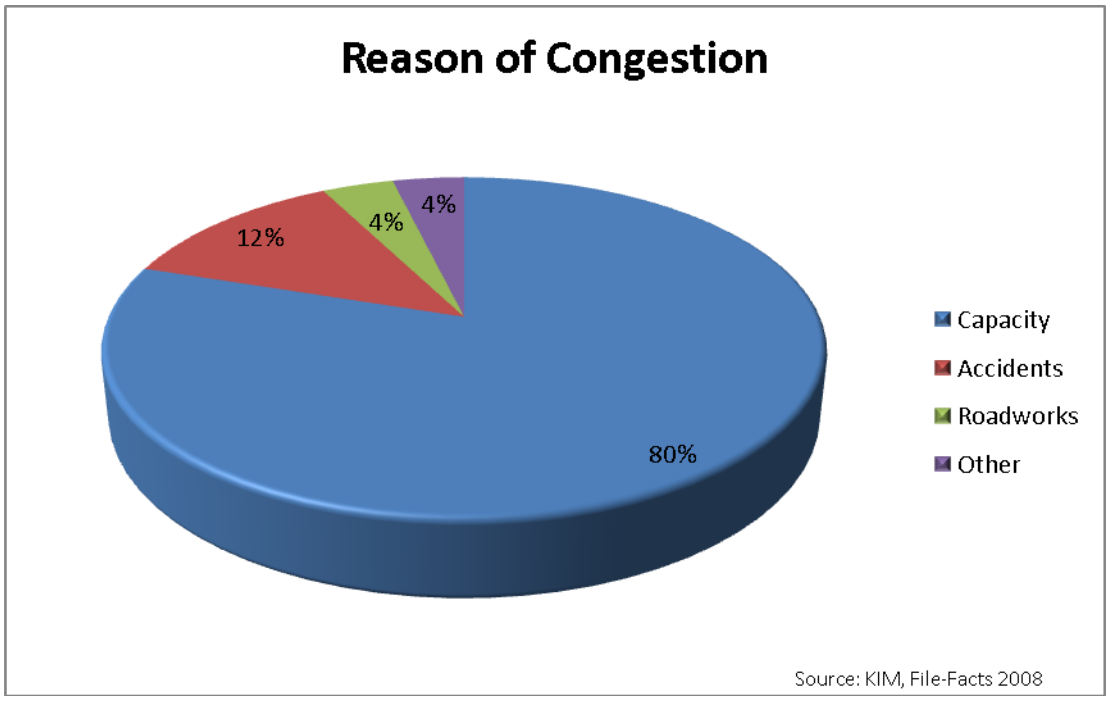




Where do we make mistakes? In one out of two cases we do not give way or we do not see or realize we have to give priority. Additionally, the time of the day influences our capabilities. The numbers of accidents in the afternoon/evening are significantly higher than the numbers in the morning.

Congestion

Main reasons for congestion are capacity.



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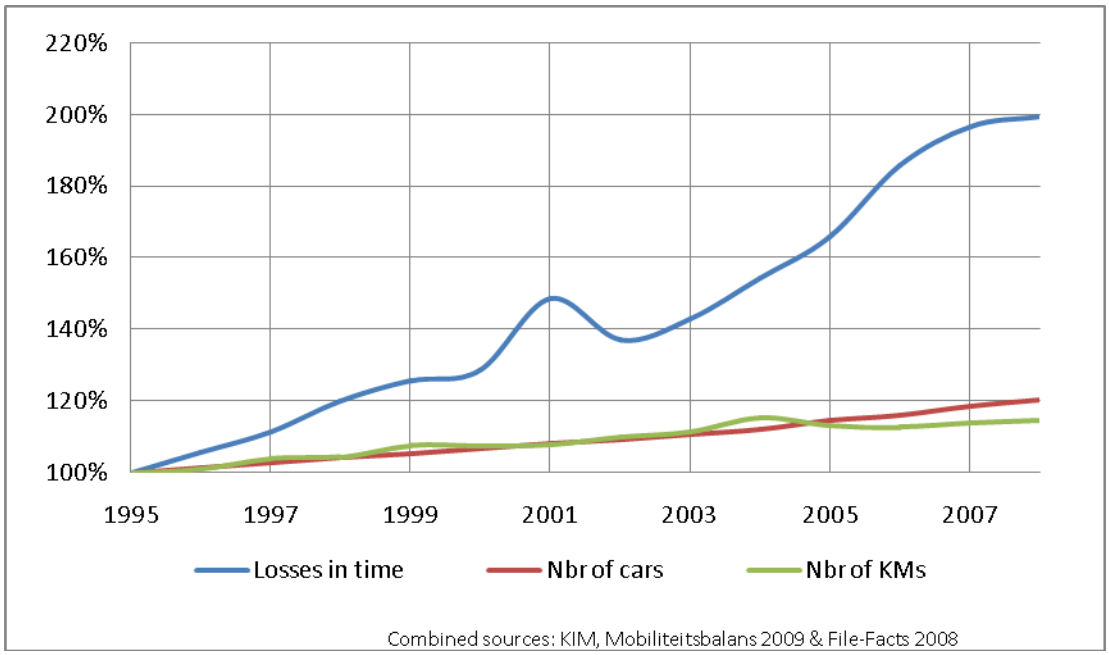
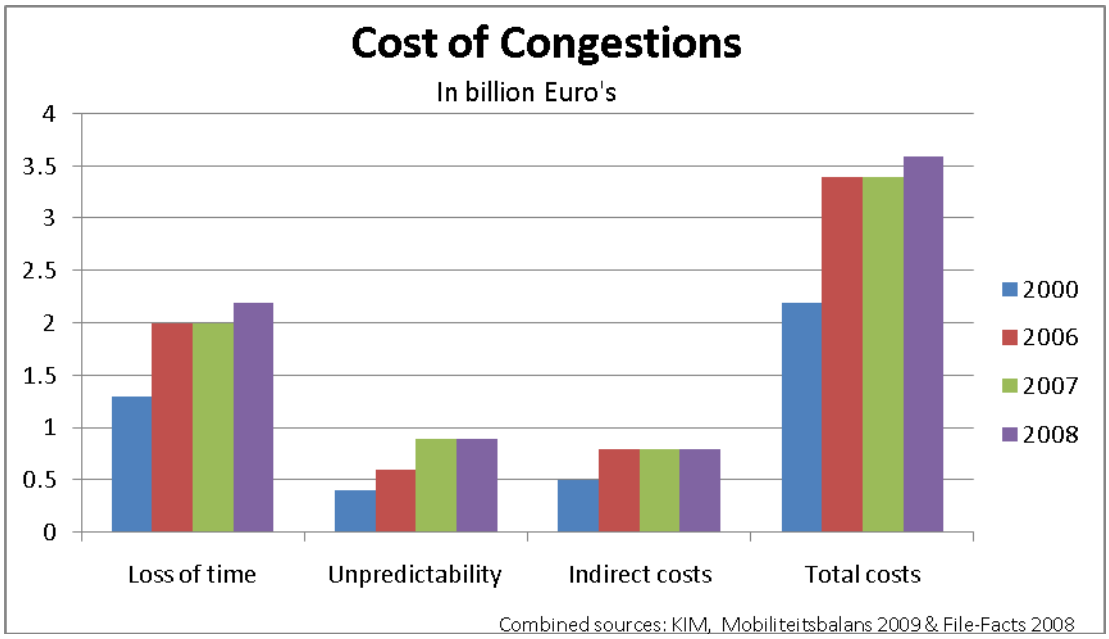
In average the capacity of a highway is around 2000 vehicles per hour per lane. When reaching maximum capacity, human behavior might influence the capacity in a negative way.



The capacity problems are becoming clear when we put the number of cars and the traveled distance in perspective of the losses in time, the losses in time grow exponential.



The total costs or congestions can be categorized as loss of time, loss of time which is due to unpredictable estimated traveling time (you have to leave earlier because you never know) and indirect costs.

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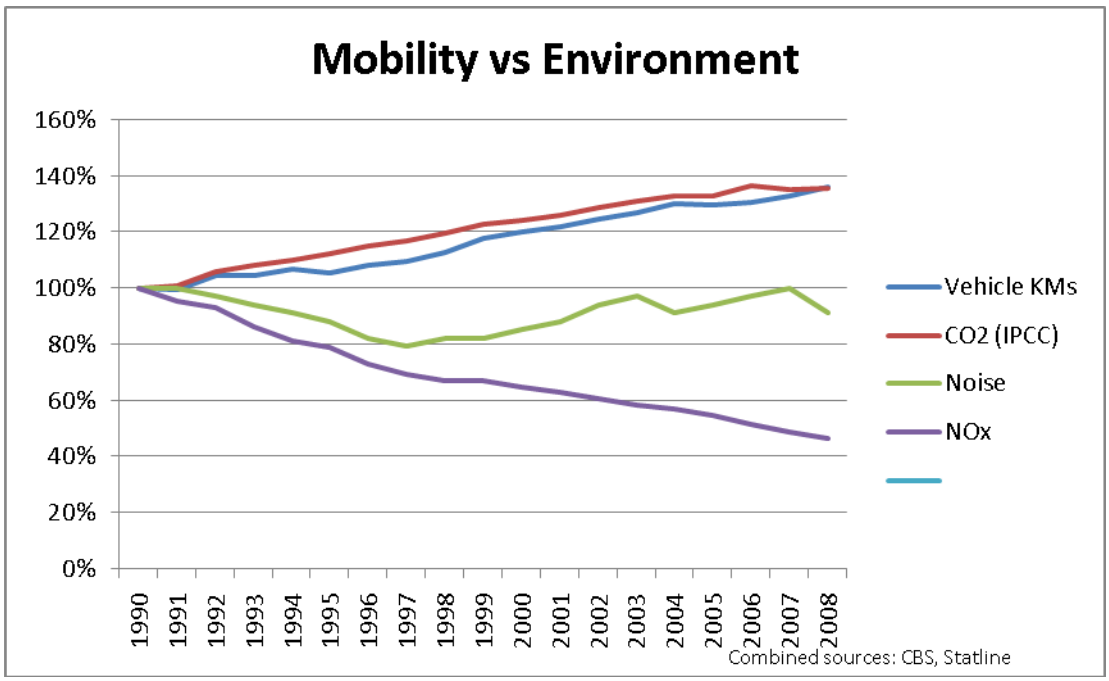
Emission

The total costs due to the negative effects of emissions are an estimated 8.5 billion Euros.



Government & Regulations

Government has by policy and regulation a strong influence on mobility. The Dutch mobility policy is based on the following aspects:

- Keep strong economies accessible and drivable
- Facilitate growing traffic demands
- Make traveling predictable
- Stimulate innovation
- International focus
- Road pricing is necessary
- Permanent safety improvements
- Improve environmental quality

Changing Industry, new products

The automotive industry is working on safe products for many decades. Recently the safety checks are extended with tests that measure the impact of a vehicle in a crash on the weak traffic participants like pedestrians. Recently “green” is gaining a lot of attention (again), partly supported by government subsidy packages. New Intelligent Transport systems are the base of further efficiency improvements of mobility. These technologies are enabled by modern ICT and mobile communication solutions.

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Future perspectives

Expected results

In order to predict the value of Intelligent Transport Systems (ITS) TNO set up a simulation model. After advanced analysis TNO states that Intelligent Transport Systems (ITS) will bring:

- 50% less traffic jams
- 25% less fatalities
- 20% less emissions
- 10% less CO_2

TNO expects that in the long run there are even better figures!

Technologies

New ICT based technologies are fundamental for ITS. A combination of smarter vehicles, affordable mobile communication and smart traffic management enables these ITS solutions.

Automotive

The vehicles are becoming smarter and smarter. With Advanced Driver Assistance Systems (ADAS) the surrounding of the vehicle is scanned and the information is used by the vehicle in order to perform more safe and efficient. Some of the information available inside the vehicle is very interesting for overall traffic management. Within the future, it is expected that more and more information between vehicles, and vehicles and infrastructures is exchanged. Establishing this kind of information exchange will bring the automotive ADAS and the ITS to the next level.

Communication

Communication is of vital importance. It connects vehicles and the two worlds of automotive and traffic.

Short range

For vehicle to vehicle and vehicle to infrastructure short range communication is required. New communication standards are in development, and a promising standard is the"automotive wifi" standard (IEEE 802.11p). This standard is based on the consumer wifi standard and is made more robust, with faster setup times, and has an increased range.

Long range

Long range mobile (phone) communication is available almost anywhere. The bandwidth of the digital communication channels is becoming high and is still increasing. The costs of mobile communication are reducing and no longer a significant (blocking) issue in the business cases. New digital radio solutions offer broadcast channels with increased bandwidth especially setup for traffic management.

Traffic management

Traffic management systems are becoming more intelligent. More and more sensors are installed on the road and the integration of traffic systems is ongoing. Huge databases (in Holland: NDW) are setup that are storing all kind of information with respect to traffic and traffic management. The new technologies will raise questions how to continue with sensoring traffic (more road sensors and cameras or go to new methods like connected vehicles that act as sensors or tracing mobile phones) and how to continue with information providing to the driver (more advanced electronic information boards or transmitting this information directly into the vehicle systems/displays, or even better, the navigation and ADAS systems.

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Challenges

Bridging the gap

Surprisingly the traffic and automotive domains are operating rather independent. In the organization like car2car.org, we see mainly automotive OEMs, and the traffic organizations seem to be rather passive. The big challenge is to bring these industries together. Note that these industries have completely different backgrounds. Automotive has a mechanical and production background, traffic has mainly a government background.

Domain Integration

As already mentioned above we have to bring different industries together, traffic and automotive. Besides that, communication service providers are also important. These providers provide long range communication services and access to the internet and related services.

Open systems

In automotive as well as traffic the systems are closed. Interfaces to the available information in the systems are not available and differ from OEM to OEM. This makes connecting automotive and traffic solutions practically impossible.

Business climate

Expensive installation

Due to the fact that the systems are not open and each OEM uses its own propriety solution, integration of third party solutions is business wise but not feasible. The vehicles are not prepared for third party ITS solutions. There is no standard interface, there is no standard protocol and there is no standardized space for mounting an ITS device. In order to make business cases positive, we need a change here. It looks like we need regulations. Note that open interfaces influences the business cases of the OEM in a negative way. Currently the OEM can setup integrated systems more cost efficient and the integrated systems provide more comfort to the users. The automotive OEMs will not give up this position that easily. The same applies for the traffic OEMs. OEMs with an installed base will have an advantage in offering extended functionality.

Who makes money?

A huge part of the cost of congestion, environmental and safety costs are from perspective of an automotive OEM and traffic system OEM indirect. How will they make money if they improve congestion? With emission we see that regulation is the driver. Again it seems that regulations and government involvement is useful.

Safety & Reliability

Currently the driver is all the time in charge of the vehicle. With increasing supporting functionality in the vehicle, the driver might lose his/her attention. When this happens, the basic rule, which indicates that the driver is always in charge, that is used in safety analysis is no longer valid when it is applied in safety analysis. This will have significant impact on the ADAS systems in vehicles.

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Human Vehicle Interaction

Human vehicle interaction is already a topic for several decades and is becoming even more and more important. More information has to be provided to the driver and the information is becoming more critical and safety related. In order to create more human like interfaces, new technologies are becoming available. An example of a new technology is the cameras that are able to read position and movement of arms and faces of the driver. Note that human vehicle interaction solutions cannot be developed in the technical domain only, cooperation with other domains is required.

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