Smart Cars – Will it be safer on the road?

A Simulation research on the effects on traffic safety of the cooperative ADA-system WILLWARN

Lucien de Baere

Graduation Date:
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Graduation committee:
Van Maarseveen
Schaap
Thomas

Organisation:
UT

Traffic safety is a reoccurring subject in discussions about mobility. Since the introduction of the car there have been many traffic victims, with an absolute low in 1972, when there were 3300 traffic fatalities in the Netherlands. During the last decennia the number of traffic victims has slowly decreased to 730 in 2006. This decrease has different causes, such as: safer vehicles, improved infrastructure and changes in the behaviour of motorists. Even though the roads have become safer, the expectation is that the number of traffic victims will increase again in the future. A possibility to avoid this increase, are the so-called ADA-systems or Advanced Driver Assistance Systems, these systems raise high expectations. The ADA-systems can be sub-divided in two categories: stand-alone systems and co-operative systems. Both categories ADA-systems raise high expectations, although the co-operative systems have the future. The co-operative ADA-systems can be further divided in sub-categories, namely systems that centralize around vehicle to vehicle information (V2V) and systems that centralizes vehicle to infrastructure communication (V2I). This research concerns WILLWARN (Wireless Local Hazard Warning). WILLWARN is based on vehicle to vehicle communication.

Goal of this research was to examine what the effects of WILLWARN will be on traffic safety. In practice many accidents are due to drivers who don not anticipate sufficient to dangerous driving conditions like: slippery roads, low visibility, obstacles and road-works. With WILLWARN drivers will be warned early so they can adapt their behaviour. To research the effects of WILLWARN the ADA-system had to be simulated in a micro-simulation model. In this research the model Paramics is used in combination with the ITS – modeller from TNO. With this model the ADA-system can be simulated as precise as possible. The ADA-system had to be simulated along with the network, the hazard and the changes in driver behaviour:

- To measure the effects, a simplified network was set up. The network consists of a nine kilometre long straight road with two carriageways. The maximum speed on this road is 80 km/h. The network has been kept simple deliberately, because the emphasis in this research lies on the impact of WILLWARN on traffic safety. A larger and more complicated network is not useful in this research.

- To create a hazard on the network, a link with a maximum speed of 15 km/h is added in the network. By introducing two small links before this link, drivers are unable to see the large speed difference timely. Because of this, vehicles in the simulation slow down at the last moment and dangerous situations start to occur. With WILLWARN vehicles and their drivers will be warned for this situation in advance and the driver can timely adapt his behaviour.

- From the moment the hazard is present on the network, it is detected by WILLWARN vehicles. When the first WILLWARN vehicle has passed the beginning of the link with the lowered maximum speed, a warning is send to other vehicles. This warning is send maximally 2,0 km from the start of the hazard. Because an individual vehicle can only send a warning over a distance of 250m, the approaching traffic is used to spread the warning. Based on this warning the WILLWARN vehicles adjust their behaviour. In time the hazard disappears from the network.

  From this moment WILLWARN vehicles will not detect a hazard anymore, and start sending a message that the hazard is gone. Vehicles who receive this message now resume their normal behaviour.

- In this research drivers will change their behaviour in two different ways. They can prematurely adjust their velocity or their following distance. Both behavioural changes are combined with a reduction of the driver's reaction time. Drivers who adjust their velocity, start to reduce their speed 250m for the hazard and reduce their speed to 50 km/h. Drivers who increase their following distance, increase their following distance with a factor 1,2. They start to adjust the distance 1000m before the hazard.

During the research different scenarios are examined. These scenarios are based on the behavioural changes of the driver and the market penetration of WILLWARN. To measure the effects of WILLWARN three safety indicators are used: Time To Collision, Standard deviation of the speed and the distribution of the deceleration. This three safety indicators give an image of the traffic safety on the simulated network.

After a comprehensive analysis of the data it can be concluded that the introduction of an ADA-system would have a positive effect on traffic safety. Even in case of a small market penetration (5%) WILLWARN has a significant positive effect on traffic safety. When the market penetration increases, the system has an increasing positive effect. In case of a market penetration of 50%, and drivers who adjust their speed, the number of dangerous situations is almost reduced to 0%.
If the two behavioural changes are compared with each other, it becomes clear that an early adjustment of the speed has more effect on traffic safety than changing the following distance. The cause of this is partly due to the fact that the decrease in speed of individual vehicles influences other vehicles on the network. When vehicles with WILLWARN decrease their speed other vehicles are also forced to adjust their speed. If the market penetration increases, this effect increases as well. More and more vehicles are influenced by WILLWARN vehicles. Because of this, an early adjustment of the vehicles speed has a greater influence on traffic safety than adapting the following distance. In case of a market introduction of WILLWARN it is desirable to give drivers the advice to adapt their speed early.