



Accelerate cooperative mobility

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Executive summary

In the past decade co-operative systems based on wireless vehicular communication have received extensive world-wide attention, and significant advances both in research, applications and testing have been achieved. The DRIVE C2X project brought together various ongoing national activities into a large European testing platform to ensure the compatibility of emerging systems with the architecture defined and specified at a European level. DRIVE C2X identified four major objectives: (i) Create and harmonize a Europe-wide testing environment for cooperative systems (ii) Coordinate the tests carried out on parallel throughout the DRIVE C2X community (iii) Evaluate cooperative systems and (iv) Promote cooperative driving. The overall aim was to identify the impacts of cooperative systems on traffic system ranging from safety to mobility needs. Hence, the PRE-DRIVE C2X consortium with the majority of the European automotive OEMs, electronics and supplier companies specialized on vehicular communication opened up to additional partners and formed the DRIVE C2X consortium to carry out European-wide field operational tests on cooperative systems. Before the project could enter user tests, there were numerous other activities for the creation of technical readiness for FOT. Despite PRE-DRIVE C2X and predecessor projects built a technical basis for the upcoming FOT, a number of efforts were needed to have C2X-system functional for extensive user tests in field conditions. The different phases of the whole DRIVE C2X methodology to support pilot tests and FOT dealt with activities for the technical readiness is represented by the tasks such as "Setting up testing tools" and "Test sites preparation" and "Data management". These had to be in order – in addition to a user test design plan - before the piloting and actual FOT could be initiated. DRIVE C2X was by far the most complex FOT ever carried out from the point of creating technical readiness for the actual FOT.

In total eight different cooperative functions were successfully tested with 750 drivers in seven European countries: in Finland, France, Germany, Italy, the Netherland, Spain and Sweden. In total, more than 200 vehicles drove more than 1,5 million km and the faultless performance of system and functions under all relevant traffic and climate conditions proved that the system is mature for Europe-wide deployment .

The safety impacts of the DRIVE C2X functions are clearly positive. Drivers react to information and warning signals.

- IVS Speed limit and Weather warning showed most potential to decrease fatalities:
 - Assuming a 100% penetration rate, IVS speed limit that provides continuous information would reduce on average 23% in fatalities and 13% in injuries. Weather Warning would lead to 6% less fatalities and 5% less injuries.
 - It is assumed that the penetration rates would be in 2020 highest 12% and 76% in 2030. For IVS speed limit, this would lead to the reduction in fatalities up to 3% in 2020 and up to 16% in 2030.
- Assuming a 100% penetration rate, Road works warning would decrease fatalities by 3%, Emergency brake light warning and Traffic jam ahead warning by 2%. These functions would decrease injuries by 2% assuming all vehicles are equipped.

The DRIVE C2X project successfully measured and analysed direct and short-term effects of drivers' use of the DRIVE C2X functions. The safety impacts of the DRIVE C2X functions

were found to be positive even for functions aimed at relatively infrequent events. Environmental benefits in terms of reduction in fuel consumption and CO₂ emissions were also achieved for three functions. Based on both user behaviour and preference measurements, the results of the project clearly show the significant potential of cooperative systems.

Also the results of the FOTs indicate positive impacts on travel comfort. Specifically, journey quality is improved in terms of decreased user uncertainty and stress, and feeling of safety and comfort.

Considering the proven safety impact as well as the perceived increase in comfort the promising user acceptance does not come as a surprise. Nine out of ten test users highly welcome the DRIVE C2X system, and that they are willing to use it if it is available on their vehicles.

In order to make cooperative systems happen on European roads DRIVE C2X was not limited to test and evaluation of C2X functions. The project did also describe deployment strategies for C2X communication based on realistic business models. The latter were developed on the basis of more than 50 interviews with representatives across all important stakeholder groups that showed evidence for economic viability and indicated that an open platform concept allowing commercial services by third parties is the key to economic success.

A working C2X system requires communication infrastructure on the roadside. Since it are still public authorities, who are supposed to invest in this, it is of utmost importance, that the ratio between the benefits of the system and its costs is clearly positive. To prove this the project has also conducted a benefit cost analysis, where monetary equivalents have been assigned to the benefits identified in the impact assessment.

Even with a low penetration rate the benefit cost ratio (BCR) was 2, showing twice as much benefit as compared to costs. With a high penetration rate the benefits could almost be seven times higher than costs. This clearly shows that an investment in cooperative systems is money well spent also for road operators and public authorities.

However, proving the benefits of a system and showing its economic viability and meaningfulness is only one side of the coin. It is equally important to create awareness for this new technology. Not only at experts' side, but also at the side of the "interested public". To achieve this DRIVE C2X organized a series of test site events with the public invited to one of them and was also present on all major ITS conferences and congresses and even produced two short videos that explain the benefits of cooperative systems in an easy to perceive way.

Besides this DRIVE c2X also contributed to the standardization of cooperative systems at ETSI and CEN and ensured, that all DRIVE C2X developments were compliant as much as possible with the standards developed there. With this it is guaranteed, that future European ITS systems are clearly DRIVE C2X based.