Cooperative driving on the road from Berlin

Martin Böhm reports on the launch of Europe's pioneering I2V project

The COOPERS demo car in Berlin

Europe's automotive industry had its first glimpse last month of the 'foresight' vehicle of the future at the 2008 IFA consumer electronics exhibition in Berlin, Germany. The show, which ended on 3 September, kicked off the demonstration programme of the 2006-2010 EC co-funded CO-OPERative systems for intelligent road Safety (COOPERS) project with the first public outing for an equipped vehicle.

Staged at a consumer electronics show – one of the largest in Europe – the event highlighted the role of the automotive industry in bringing key ITS applications to road users. COOPERS aims to speed up deployment of infrastructure-to-vehicle (I2V) and vehicle-to-infrastructure (V2I) communications using wireless technology, in the context of the European cooperative driving systems programme.

The resulting enhanced links, using existing networks as far as possible, will give drivers better access to real-time, location-based, safety-related information on current traffic conditions. The project also sees improved traffic management as a beneficial spin-off.

At the IFA showcase, EC officials and automotive and road operator industry representatives took virtual test drives on the Berlin urban motorway network. They were able to experience the effects of improved infrastructure-driver communications on their awareness of upcoming traffic jams and incidents.

Emphasising the role of operators, Jacques Boussuge, from the Association of French Motorway Companies (ASFA), said: 'Our main objective is to increase safety and mobility.' With forecast increases in traffic of between 30% and 50%, and parallel zero accident/ congestion scenarios, 'we need to extend the infrastructure by using modern technologies such as those being developed in COOPERS'.

Reinhard Pfliegl, Managing Director of COOPERS Coordinator AustriaTech, envisaged operators eventually using the system to give legally-binding instructions to individual drivers. Visitors also gained insights into early project results, including those of a simulation carried out in summer 2008 at the Swedish National Road and Transport Research Institute (VTI) – see table 1.

Said Pfliegl: 'Following receipt of an upcoming foggy motorway section, drivers immediately reduced their driving speed by 10km/h. They reached the dangerous stretch at a speed 15km/h lower than with the system switched off.'

The two key practical challenges facing COOPERS are information delivery and quality. On the first, European road operators currently transmit road safety-related data to drivers via digital radio broadcasting on the traffic message channel (TMC).

This can take up to ten minutes – too long for safety-critical warnings. COOPERS aims to reduce the delay to 30 seconds.

On the second, information currently arriving from a number of sensor sources, and being fused with data from with external services such as weather forecasters, needs to be attached to specific locations; eg the incident site, or the beginning/end of a dangerous stretch. This demands a permanent I2V link.

The project is putting special emphasis on the TPEG-RTM COOPERS standard which it has already developed for encoding and decoding travel information messages, and which will be publicly available after the test phase. This covers broadcast media (eg DAB, DVB-H), cell-based technologies (eg GPRS, WiMAX mobile) and medium- to short- range communications (eg CALM-IR).

The next stage involves implementing a three-step development programme at four demonstration sites – see table 2. These will all use different communications technologies, enabling evaluation of their respective impacts on COOPERS service delivery, and present information to drivers language-independently. The three steps are:

1. Improvements to existing road-sensor infrastructures and traffic-control application algorithms, to enable traffic control centres (TCCs) to deliver more precise, situation-based traffic information and driver advice. On-board units (OBUs) will be connected to the infrastructure via wireless I2V communication links. COOPERS also aims to identify scope for the enhancement of data quality (eg by adding extended floating car data (xFCD) and processing).
2. Development of a communication concept and applications able to cope with such I2V requirements as reliability, real-time capability and robustness; and with a range of transmission technologies. This step will also include the establishment of a link for using road data from tolling and in-vehicle sensors to aid decision-making within TCCs.
3. Building permanent communications links between road operators' TCCs, with near to real-time data transmission; and between motorway infrastructures and vehicles.

To avoid any interaction with the operation of existing systems during the demonstrations, the project is transferring all relevant data from the sites to dedicated COOPERS service centres.

Demonstration sites

The Brennero Corridor links the cities of Munich (Germany), Innsbruck (Austria) and Trento (Italy) and three highway operators: OBB (Germany), ASFINAG (Austria) and Autostrada del Brennero (Italy). The demonstration site consists of three 'hotspots' each about 20km long, one for each operator.

By bringing together, in intensive cooperation, operators in different countries, COOPERS aims to demonstrate service continuity across successive national borders. It will use mainly short-range communications (CALM-IR).

The Netherlands-Belgium site lies along the 80km-long Rotterdam-Antwerp corridor, one of the most intensively used road networks in Europe. The roadside system will receive data from three regional traffic management centres (TMCs), one in Belgium and two in The Netherlands. Of the latter, one – in Utrecht – is physically connected to the traffic information centre (VCNL) run by the Rijkswaterstaat agency of the Dutch Ministry of Transport.

During the demonstration, 120 selected drivers will, in turn, take two test vehicles along this corridor over a three-month period, collecting over 10,000km worth of test results en route.

The German demonstration route lies on the inner-city motorway network of the Berlin capital region, which goes through a densely-populated area and is characterised by numerous curves and entry/exit slip roads. The test site contains four major interchanges and some 30 junctions with the secondary road network.

The city's central TCC will acquire raw sensor data from relevant traffic management systems for analysis. The TCC, run by the Berlin Senate Road Authority, operates the city's traffic signals and variable message signs (VMS) and has a link to the Traffic Information Service Provider (TISP), operated by the city's TMC.

The TISP will enrich the results with its own sensor data and transmit them to participating vehicles via DAB and TPEG channels. A back-channel from the vehicles will transmit in-vehicle data via GSM/GPRS to the TISP, to enable this to enhance its own services.

In a second German location, the city of Darmstadt, COOPERS is calibrating and testing a 'robust positioning unit' which will form an integral part of the OBU in demonstration vehicles. Darmstadt will not, however, be hosting any test drives.

France has five COOPERS sites on motorways run by four operators – ASF, ATMB, SANEF and SAPN – which are sharing the research activity. French operators already have a robust background of traffic management systems based on an extended infrastructure of enhanced monitoring and information services, and see prospects of improving these.

The demonstration will focus mainly on traffic management techniques and their impacts on efficient operation. It will address issues concerning the integration with existing information systems of new COOPERS services.

Introduction of these will give a good overall idea of the traffic management system of the future, making extensive use of both I2V and V2I communications via continuous bidirectional wireless links.

Looking forward

COOPERS represents an important step towards establishing the feasibility and acceptability of co-operative traffic management, which aims to increase the safety of driving in all traffic situations, with reliable wireless I2V links as the critical technical issue. Its long-term vision is of in-vehicle instructions to drivers replacing roadside travel information (eg via VMS). Hence the focus on real-time, location-based information to ensure that all drivers in a given location receive the same information at the same time from the infrastructure operator.

There are, obviously, legal issues to be addressed; one of which will involve mandatory requirements for OBUs installation.

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Road safety-relevant information services as defined within COOPERS:

- Upcoming 'accident/incident ahead' warning;
- Upcoming 'weather conditions ahead' warning;
- Upcoming roadworks information;
- Lane use policy and occupancy information;
- In-vehicle variable speed limit information;
- Upcoming traffic congestion warning;
- Intelligent speed adaptation (ISA) operation, with continuous infrastructure link.

Table 1: Swedish simulation findings

Condition	System gave support for driving decision%	System affected driver behaviour%	System calmed driver%
Congestion	52	92	63
Fog	42	92	67
'Ghost' (wrong-way) driver	100	63	58
Ambulance coming up from rear	100	69	69

Table 2: COOPERS demonstration sites

Site	Location	Comms technology
1. Brennero corridor	Germany/Austria/Switzerland	Mainly CALM-IR
2. Rotterdam–Antwerp Corridor	The Netherlands/Belgium	Mainly GPRS
3. City of Berlin	Germany	Mainly DAB
4. Caen-Paris and Valence-Lyon-Chamonix corridors, city of Metz	France	Initially GPRS; possibly a later enhancement using CALM technologies