Cooperativity in motion

Networking is key to the traffic of the future
“For maximum benefit we need to invest not only in vehicles, but also in infrastructure. Making the vehicles communicate with each other brings considerable benefits, but the maximum benefits arise where intelligent intersections and intelligent motorways are able to monitor the vehicles’ movements and control traffic flows – for a safer traffic landscape.”

Paul Mascarenas,
CTO and Vice President,
Ford Research and Innovation
900,000,000 new partners for transport infrastructure

The efficient control of traffic flows presupposes the availability of reliable data on the current situation. Up to now, these data generally came from detector systems installed in the road surface, at the roadside or on gantries, and sometimes from specially equipped vehicles, for instance taxis. Data of the latter type are called “Floating Car Data,” an method that in some conurbations allows us already today to use the travel data of taxis to feed our Sitraffic® traffic centers with constantly updated data on the prevailing traffic conditions.

But what is currently emerging as the technology of the future will be nothing less than a revolution in traffic data acquisition: Some time in the future, not only a few vehicles will serve as data suppliers, but any and all! At the last count, there were a full 900 million vehicles across the world!

In the future, an integral part of the transport infrastructure will be the fully networked car, communicating with the infrastructure but also with other vehicles. Within the next five years, we will see vehicles able to connect with each other and with the road infrastructure – anywhere and at any time and traffic management systems will send situation-specific information to individual vehicles, at any point of the road network. With all that, the “Vision Zero” project of the European Union (EU) and the German Road Safety Council (Deutscher Verkehrssicherheitsrat / DVR) could soon be much closer to the realization of its great hope and dream: No fatal traffic accidents anymore!

On the following pages we will present the partners involved as well as the technologies and solutions that are available already today for the implementation of “Cooperative Transport Systems.” Because now the time has come for the innovative systems to leave the research laboratory and conquer the road as real products. Discover the incredible range of inspiring options they offer!

“The car of the future will be networked,” predicts the automotive industry, calling the concept “connectivity.”

“Tomorrow’s infrastructure will incorporate the car,” say the infrastructure system providers, announcing cooperative systems and real-time data exchange.

“More information flow than ever!” says the IT industry, promoting Car-to-X (C2X) communication.

“We need globally uniform standards,” say the standards committees – and get down to work.

“We want cooperative mobility to reach the road in 2015!” says the European Commission, pushing the implementation of a European Car2X corridor from Rotterdam to Vienna.

“We hope for a significant reduction in congestion and environmental pollution!” say the municipal authorities, waiting impatiently for what the cooperation partners will achieve.
In Europe, a truly inclusive cooperative project is under way – with the goal of making the traffic of the future safer, more convenient and more efficient. Two major organizations involved in this meta-mission are the CAR 2 CAR Communication Consortium and the ERTICO-ITS Group. In the consortium, motor vehicle manufacturers and other industrial companies are working jointly on the development of consistent standards for Car2X communication. The ERTICO-ITS Group has a wider scope: Its more than 100 member organizations endeavor to introduce more intelligent options for the transport of people and goods across Europe. ERTICO has members from all sectors and areas, working closely together in different committees: from automakers and their suppliers to representatives of government agencies and university faculties, from manufacturers of navigation devices to infrastructure operators, from standards committees to suppliers of road infrastructure systems – everybody contributes their knowledge and experience and shares their ideas and wishes. This is true cooperation to everyone’s benefit – “Cooperativity at work!”

The goals set, the visions behind them and the progress made in various areas – read more about all that on the following pages.
Cooperation between all entities involved is the key to the networked traffic of the future

The labels may differ, but the idea remains the same: No matter if it is called Car2X, Cooperative Transport Systems, Connectivity, Cooperative Mobility, Connected Drive Technologies – in the end, all those terms stand for a future transport system where all vehicles and infrastructure systems are interconnected with each other by wireless communication. This connectivity will provide significantly more precise knowledge of the local and area-wide traffic situation across the entire road network, which in turn will help optimize traffic flows, reduce congestion, cut accident numbers and minimize emissions. The leading vehicle manufacturers have collectively decided to introduce the required technologies as a series feature in all new up-market vehicles as of 2015/2016. At the IAA 2013 in Frankfurt, you will be able to admire the first outcomes of this strategy.

33 percent higher accuracy in traffic forecasts? Quite feasible!
The “City Cockpit” project pursues an ambitious goal: All available data, results, possible influencing factors and causal relations are to be recorded, analyzed and used to arrive at a holistic picture of the inner workings of cities, conurbations and metropolitan areas. Besides traffic management, this will include water, energy, emergency and sustainability management. The idea is to provide mayors and other decision makers with a tool that allows them to monitor and analyze the processes in their city in real time. In Singapore, Siemens has already implemented a prototype of the City Cockpit system.

But such a comprehensive analysis tool will not really work without a real-time-capable traffic management system. The technological foundation is being developed in the scope of Real Time Traffic Forecast (RTTF), a sub-project of City Cockpit. In Berlin, the IT provider Atos, Paderborn University, the operating company of the Berlin Traffic Management Center and Siemens were able to demonstrate the huge benefits offered by real-time-capable traffic management. The most exciting result hitherto: A 33-percent increase in the accuracy of traffic forecasts – up to four hours in advance!

The prototype system in Berlin collects traffic data registered by 1,200 measuring stations (800 installed on urban freeways, 400 on inner-city streets). Going far beyond the customary blanket statements such as “congested road” or “slow-moving traffic,” the data allow the calculation of precise traffic density figures, which in turn are the basis for deriving an exact picture of the prevailing traffic situation. The cooperation partners involved in the RTTF project were able to reduce the divergence between traffic forecast and reality from a hitherto normal 40-percent deviation to a mere 7 percent.

San Francisco has signaled interest in the system, other cities are sure to follow.

Concerted action of the automotive industry: simTD outdoor test
“Sichere Intelligente Mobilität – Testfeld Deutschland” (simTD: Safe Intelligent Mobility – Testing Field Germany) is the name of a project realized in 2012 in Frankfurt/Main in a field test in ordinary street traffic. In one of the world’s largest field tests for vehicle-to-vehicle and vehicle-to-infrastructure communication, a total of 120 networked test cars traveled with the main traffic flows in and around Frankfurt, exchanging information with each other and transmitting data to the traffic centers. This project too was a prime example of intensive “Cooperativity in motion” – the project partner list reads like a Who’s Who of German automakers, their suppliers and the competent research institutes:

Adam Opel AG, Audi AG, BMW AG, BMW Forschung und Technik GmbH, Daimler AG (project leader), Ford Forschungszentrum Aachen GmbH, Volkswagen AG, Robert Bosch GmbH, Continental, Deutsche Telekom AG, Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (DFKI), Technical University Berlin, Technical University Munich, University of Applied Sciences Saarland, University Würzburg, the Hessian road and traffic management agency Hessen Mobil and the city of Frankfurt/Main.
Dr. Christian Weiß, Project Manager simTD, Daimler AG

“With simTD we are now deploying a pioneering technology for the creation of communication networks between vehicles and between vehicles and the infrastructure. This will make motorized travel safer, more convenient and more efficient.”

European Union:

- ITS Action Plan: The central goal is the communicative networking of vehicles and infrastructure
- ERTICO – ITS Europe: Supports the implementation of cooperative systems through various projects, for instance the foundation of the “Cooperative Mobility Alliance.” Has over 100 members representing governments, industrial companies, standards committees and infrastructure operators
- CEN (European Committee for Standardization), CENELEC (European Committee for Electrotechnical Standardization) and ETSI (European Telecommunications Standards Institute): Develop the standards needed to ensure interoperability of cooperative systems and components

Industry:

- CAR 2 CAR Communication Consortium. Develops and coordinates the fundamental conditions and strategies for Car2Car and Car2Infrastructure communication
- Amsterdam Group: Infrastructure operators and members of the CAR 2 CAR Communication Consortium are working jointly on the preparation of “Day 1”, defining and developing applications and services for cooperative transport systems for the deployment of the first generation of solutions
- Car manufacturers that are members of the CAR 2 CAR Communication Consortium have committed to introduce vehicles with Car2X technology on the market as of 2015

Creating the fundamentals: Key projects and major cooperation partners

City Cockpit in Singapore integrates transport, water, energy and emergency management

A push of the button sets all traffic lights to green for the rescue vehicle

Satellite-based navigation is a key tool in Cooperativity
Cooperativity gets cars to talk – literally! Because soon cars will be able to provide their drivers with valuable information. For instance: “Traveling at 30 mph will give you green lights up to Oak Street” or “Attention; broken-down vehicle half a mile ahead” or “Green light will follow shortly.” The vehicles will receive the required input from road infrastructure elements such as traffic lights or traffic control systems – or from other cars. Inversely, the cars will be able to “talk” to the infrastructure and trigger certain system responses. The integration of traffic and emergency management systems will make it possible, for instance, to steer an emergency vehicle to the hospital with sufficient free capacity that can be reached in the shortest time – instead of to the nearest hospital, whose operating rooms are all busy at the moment. And all traffic lights on this route are automatically switched to green for this vehicle.

To implement such (and many other!) functions, we need powerful communication standards and shared interface protocols, which are to be used consistently by everyone involved. Improved technical integration is a must – and the object of a wide range of cooperative efforts. As you see, “Cooperativity in technology” is making good progress!
Networking vehicles and infrastructure paves the way for the deployment of numerous applications that will generate valuable benefits for traffic and beyond. Some important applications that are already on the horizon …

• Warnings alerting road users to current local danger spots ...
  ... increase traffic safety, help reduce the number of accidents and injuries

• Real-time traffic information ...
  ... helps optimize traffic control and improve the efficiency of the transport system

• Intelligent public transport prioritization ...
  ... makes PT service more punctual and attractive, promoting the switch from private to public transport

• System integration using City Cockpit ...
  ... makes managing cities and conurbations easier, from transport and water and energy utilities to emergency management and sustainability goals

• Accelerating the flow of traffic ...
  ... helps minimize fuel consumption and emissions

• Signal phase information made available in the car ...
  ... speeds up lines of vehicles, increases vehicle throughput, cuts fuel consumption

• Wrong-way driver warning ...
  ... increases road safety

• Internet made available in the car ...
  ... brings a wide range of applications to vehicles ("car apps")

• Internet-based search for parking spaces, including payment facility ...
  ... helps reduce parking-related traffic and optimize parking facility management

The basic principle is cooperation, i.e. the exchange of information between all road users, from road and rail vehicles to cyclists and pedestrians, and between road users and infrastructure elements such as traffic lights and road signs. All that happens in real time and at high speeds.”

Fritz Kasslatter,
Research Group industrial networks Austria

Numerous applications, abundant benefits
Cooperation needs communication – and powerful standards

Two kinds of “senders”, three types of communication
The concept of Cooperativity involves two kinds of “senders” – vehicles and infrastructure elements – and three different communication situations – communication between vehicles (Car-to-Car, C2C), between vehicles and infrastructure elements (Car-to-Infrastructure, C2I) and between different infrastructure elements (Infrastructure-to-Infrastructure, I2I). Consequently, the establishment of this complex network requires all vehicles manufacturers, all infrastructure system providers and all producers of mobile devices such as smartphones and navigation systems to define and use common communication standards. The good thing is …

All technologies needed are already available and the corresponding communication frequencies have been reserved
All technical prerequisites for enabling communication between the different players involved are already available:

- Mobile radio standards such as GPRS, UMTS
- Transmission standard for DAB digital radio
- Technologies for WLAN-based short-range communication for mobile devices (IEEE 802.11a, IEEE 802.11p)
- Satellite-based positioning technology (GPS)
- Wireless access to broad-band Internet, for instance using infrared or microwave technologies such as DSRC and WiMAX

Standardization committees like ISO and ETSI have already paved the way for the use of specific frequencies in traffic-related applications. Worldwide, the frequency range between 5.875 and 5.925 GHz has been reserved exclusively for Cooperative Transport Systems.

Cooperation benefits everybody
The automotive industry is working all out on equipping the vehicles of the next generation with the required technologies and interfaces. The "Marktbarometer 2012" survey conducted by the German motor magazine "Auto-Bild" shows that the respondents are prepared to spend an average of €3,000 on a communication package for their new cars if they are informed in advance about the applications “in the pipeline.” This sounds like a good incentive for the car manufacturers to try and meet their customers’ wishes.

Cooperative technology packages will offer car users a whole range of new options. The provision of dedicated “car apps” is just around the corner. For instance, drivers will have the possibility to select and buy services that are based on local data and can provide them with information on available parking spaces or access rights to certain areas, with up-to-date roadworks alerts or recommendations for switching to other modes of transport.

Cities and operating companies in turn want to ensure the smooth flow of traffic, improve road safety, keep travel times short and emission levels low. For them, a key benefit of cooperative systems is the availability of real-time data from the vehicles that make the work of the traffic control centers easier and more effective and enable more precise traffic guidance tailored to the prevailing situation. With its manifold functions, from rescue vehicle and PT prioritization to local danger alerts and variable speed recommendations delivered right to the vehicles, the Cooperative System landscape will make managing a city so much easier. And, as the "City Cockpit" section shows, the benefits go far beyond the field of mobility.
Cooperative transport solutions are well on their way from the development lab to the road network. Research into the basics has been virtually completed, now all entities involved are working on the development of practical products and solutions for C2C and C2I/I2C communication.

In some areas, Siemens is one step ahead. For instance, our portfolio already includes cooperative components such as controllers and communication modules that comply with the new standards and are designed for interaction with the "new players" in the future. For Siemens, the integration of roadside infrastructure with traffic control and management centers has long been a standard feature of their solutions. Because the so-called I2I communication is a regular part of daily business for the largest international provider of traffic engineering infrastructure. How else could we ensure the smooth functioning of those many hundreds of Siemens traffic control centers installed around the world?

But now communication in traffic engineering is being taken to a new level: Cooperativity, the vision of the beneficial networked cooperation between the hitherto largely autonomous systems installed in vehicles, roadside infrastructure and traffic centers is now becoming reality on Europe’s roads. And Siemens is certainly "Ready for Cooperativity.”
Testing field? Real life? The two spheres are merging into one as Cooperativity is conquering the road

Vienna: 30 miles of cooperation in private motorized travel
South of Austria’s capital, Siemens has implemented the “Testfeld Telematik,” a testing field covering 30 miles of road including the A2/A23-A4 freeway intersection as well as connection points to public transport (S-Bahn 1). In this area, around 150 sensors and over 150 cameras monitor the traffic situation, from current travel speed and traffic flow to possible obstacles and potentially disruptive weather conditions such as black ice, rain and fog. A total of 25 vehicles equipped with Car-to-X technology travel along as part of normal traffic flow, providing valuable real-time data to the traffic center and to other vehicles. “Slow-moving traffic a quarter mile ahead” or “Green wave if traveling at 35 mph” are two of many messages that can be derived from the data and transmitted to the drivers. Soon the testing fleet is to be extended to 100 vehicles. The prototype communication systems used for the test can later be integrated in the existing freeway and street infrastructure in Vienna.

Brunswick: AIM – Application platform for Intelligent Mobility
Brunswick has a large-scale research facility for intelligent mobility services. Here the researches develop application-oriented systems and investigate options for regional and local traffic interventions. All that on Brunswick’s general urban street network. Of special importance for us is a concept for public transport prioritization developed in cooperation with the German Aerospace Center (DLR) in the scope of AIM. The reason: The new cooperative systems allow to expand the hitherto feasible and customary prioritization schemes and to be improved, for an even more effective acceleration of public transport. In Brunswick, AIM has been prepared for the future inclusion of the public transport system.

Palm Desert, California: Siemens and BMW demonstrate possible designs for safety solutions at intersections
In the US, too, Car-to-X communication is widely discussed. And as leading provider of traffic management systems and traffic infrastructure, Siemens is playing an important role in this development. Some years ago, Siemens joined forces with BMW and the California Department of Transport to conduct a field test of a short-range communication system. The system constantly monitored the distance between a BMW7 and the nearest traffic light. Since the vehicle and the traffic light controller were communicating in real time, the car “knew” when the light would turn to red and turned off its engine at the right moment to save fuel and feed the breaking energy to the battery. This not only optimized traffic flow and reliably prevented accidents due to cars jumping the red light, but also led to up to 15 percent fuel savings for the test vehicle.
“Europe is setting new standards. The Netherlands, Germany and Austria are currently implementing a Car-2-X corridor reaching from Rotterdam via Frankfurt to Vienna as a real-life application of Cooperative Technologies on Central-European roads. In the first stage, the system will provide roadworks alerts and use vehicle data to monitor the traffic situation. Things are moving forward!”

Roland Wunder, Project Manager Cooperative Transport Systems, Siemens AG

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**Siemens: Ready for Cooperativity!**

What the Siemens portfolio offers already today:

- Processing of Floating Car Data (FCD) in traffic light systems (data fusion, calculation of the current local traffic situation)
- Transmission of signaling and traffic data from the traffic light systems to individual vehicles (switching time count-down)
- Collection and processing of FCD at the traffic center made possible by the installation of a dedicated interface connecting the center to an FCD server, for instance
- Transmission of traffic center data to an information server for distribution to vehicles on the road
- Sitrack C940ES controller with WLAN capability according to IEEE.802.11p
- Scalance communication module for the transmission of signal switching data and traffic information to individual vehicles

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Real-time information turns the navigation device into a “mobility manager”

Safer, faster and less fuel-consuming urban travel

The Scalance module from Siemens transmits data to vehicles – in the city and on the freeway
The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.