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**CAR 2 CAR**  
COMMUNICATION CONSORTIUM

*Editorial*

*Dear partners and members*



*This is the first of two newsletters, which you will receive this year. In future we will keep you informed of all the latest developments in the CAR 2 CAR Communication Consortium on a semi-yearly basis. The layout will be kept simple: The first two pages will contain short and brief newsflashes to enable a quick overview of the CAR 2 CAR Communication Consortium. The following pages contain proceedings in workgroups and activities focused on vehicle communication.*

*The level of needed information may vary from member to member, due to different grades of membership and engagement in the consortium. If required, supplementary information can be extracted from the annex.*

*In this Newsletter release we would like to inform you about the CAR 2 CAR Forum taking place on the 22nd and 23rd of May in Ingolstadt. It is the first of its kind and offers all members and partners the possibility to keep up with the newest in CAR 2 CAR Communication Consortium.*

*The forum will put its emphasis on political and technological issues in Europe and other regions besides revealing the current status of the Consortium including CAR 2 CAR applications, development potentials, and market entrance possibilities.*

*On location you will receive a CAR 2 CAR Communication press kit. As you can see our efforts to attract public interest are intense. The time to act is now and we are looking forward to our future cooperation.*

*Yours faithfully,  
Rudolf Mietzner  
General Manager*



## At a Glance: The CAR 2 CAR Communication Consortium by Rudolf Mietzner

Since 2002 - Wireless-LAN (IEEE 802.11 a/b/g) technology has become a method of data transfer not only affordable but also useable by the mass market. This sparked an immediate response at innovative research and development departments of various car manufacturers, thinking about how this can be applied to road traffic on a safety and efficiency level. WLAN and On-Board-System technologies of different fields are linked to a widely available information network, which enables the driver to recognize up coming danger potentials at an early stage in order to minimize the risk and to therefore improve the traffic flow by CAR 2 CAR Communication.

Before implementing such a project, certain adjustments have to be made. One has to uniformly create standards, including European Standards in technology aspects – like finding a suitable radio frequency which is equal for all users on economical and technical terms.

Consequently meaningful car manufacturers formed the CAR 2 CAR Communication Consortium. It is a non profit oriented organisation of research institutions, suppliers and other partners focused on this field, which is open for new members – who focus on similar subjects. The consortium itself will act as a kind of interface in the network „CAR 2 CAR Communication“. You will find the detailed organisation diagram after login at: <http://www.car-2-car.org>. It works on a unified system that will support

the applications of “active safety“. This will contain leadership of adjustment processing among German and European Authorities and all parties concerned, furthermore the harmonisation of global standards.

The „CAR 2 CAR“ Forum on the 22nd and 23rd of May 2007 in Ingolstadt will be the first official consortium meeting in front of a public audience. It is the first of its kind and offers all members and partners the possibility to keep up with the newest in CAR 2 CAR Communication Consortium.



Figure: Participants of the Simulation Workshop

The forum will put its emphasis on political and technological issues in Europe and other regions besides revealing the current status of the Consortium including CAR 2 CAR applications. Workshops will be taking place on these matters exposing useful background information on development potentials, and market entrance possibilities and industrial architecture.

On location you will receive a CAR 2 CAR Communication press kit. As you can see our efforts to attract public interest are intense. The time to act is now and we are looking forward to our

future cooperation. It will be a well filled program to which we hope to see many of our members visiting, at least the disciplines concerning their field of interest. In addition opportunities will be given in order to discuss the latest developments and to interchange information. Details to our event and how to register are displayed on our website: [www.car-2-car.org](http://www.car-2-car.org) under the header „CAR 2 CAR Forum“.

### Technical Requirements:

Main Topic – Frequencies.

Only one example for the working field concerning the CAR 2 CAR Communication Consortium and the requirements for Vehicle – Vehicle Communication is the communication on a harmonised frequency.

Safety relevant applications not only have to be free of charge but also quick and reliable. This makes a separate Vehicle - Vehicle Communication Frequency indispensable.

During this undertaking essential progress has been made and all CAR 2 CAR members have come up with a decision on which frequency will be used.

The CAR 2 CAR Communication Consortium will also take part in further talks with the EU and will act as communication partner as well as coordination figure. For this reason the COMeSafety project has been launched. It will act as a Special Support Activity (SSA), and was launched in cooperation with the EU in 2006.

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## Membership News: Basic Membership Implementation

Complementary to the active membership the CAR 2 CAR Communication Consortium offers a Basic Membership to all persons being interested in the topic of inter-vehicle- and vehicle-to-infrastructure-communication since January 2007.

This type of membership is open to all parties that are interested in receiving information about inter-vehicle and vehicle to roadside communication and all related topics and activities. However requests for a Basic Membership have to be confirmed by the CAR 2 CAR Communication Consortium.

Basic Members will get privileged information about inter-vehicle and vehicle-to-roadside communication including all related topics and activities.

### Services for Basic Members:

The CAR 2 CAR Communication Consortium provides the following services/benefits to all Basic Members:

- Two Newsletters per year distributed by e-mail and offered for download from the Consortium Area, which topically inform among other things about frequency allocation and standardisation, national and European activities, testing and demonstration.
- Invitation for participating in the annual two days CAR 2 CAR Communication Consortium Forum, which is alternating hosted by one of the Members. If practicable the Forum will be complemented by an exhibition of the CAR 2 CAR Communication Consortium and a technical visit of the hosting Member.
- Access to the Consortium Area on [www.car-2-car.org](http://www.car-2-car.org), which permits the download of officially released CAR 2 CAR Communication Consortium documents and publications given by the members of the CAR 2 CAR Communication Consortium, such as performance guidelines, drafts of technical and

frequency standards, position papers, studies, reports, presentations, newsletters, etc.

Basic Members of the CAR 2 CAR Communication Consortium are subject to an annual fee for financing the service, for each person who is a member. For further information or registration please send an e-mail to: [heyms@gzvb.de](mailto:heyms@gzvb.de)

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## Consortium News

### Workgroup: Architecture

by Konrad Roßbrucker

The EU-funded project COMeSafety serves – among other topics like frequency allocation – as a unique platform for co-ordination and consolidation of the results emerging of the European and national projects as well as the outcomes of initiatives like the CAR 2 CAR Communication Consortium (C2C-CC) to prepare the standardization process with respect to all technologies for vehicle-to-vehicle and vehicle-to-infrastructure communications.

Especially a harmonised communication architecture appears to be a precondition for interoperable safety applications throughout Europe. Hence the COMeSafety project established a Common Communication Architecture Task Force (chaired by Dr. Timo Kosch) to enable and facilitate the development and deployment of safety applications based on a harmonised architectural framework.

For these purposes an Architecture Workshop on 27th of November 2006 was organized in order to align and coordinate future architecture work in the area of safety and traffic efficiency applications. The participants of the workshop arrived at the conclusion that

- “Architectures developed in C2C-CC and CALM should be considered as a “starting point” for future architectural work. This approach will accelerate the achievement of agreed architectural building blocks. A fully fledged “top-down” scenario approach is regarded as too time consuming, but a few common dedicated scenarios or scenes of a scenario will be carved out as a common basis.”
- “C2C-CC is a good candidate to “host” future common architectural descriptions and their maintenance”.

In the meantime a draft of a deliverable how to achieve and describe this architecture has been developed and is currently under review. The next step is to negotiate and approve a milestone plan for the complete architecture task. Since C2C-CC is regarded as a “host” in terms of providing input and inversely maintain a consolidated architectural descriptions, the Architecture Task Force is an attractive opportunity for all C2C-CC members to benefit from architectural harmonisation work or even to influence the architectural work. Every member is invited to participate!

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### Project Environment News

#### NISSAN: Intelligent Transport System using cell phones

Advanced ITS using cellular communications aimed at helping to reduce pedestrian accidents  
<http://www.nissan-global.com>

#### Continental: New type of precrash sensor is able to prevent many accidents in urban traffic.

Continental Automotive Systems' closing velocity sensor assists the driver in braking. Consequent enhancement of passive safety integration strategy. First models in series production in 2008.

<http://www.conti-online.com>

#### Elektrobit Automotive Software Creates Wide-band Access to Autos

The Erlangen software company Elektrobit Automotive Software is bringing the first certified TCP/IP stack for automotive control devices to the market. With a data throughput of about 3 MB per second, the TCP/IP stack opens new possibilities for fast data access to autos. Download the complete article (.pdf)

### Workgroup: Standardisation

by Dieter Seeberger & Sören Hess

#### Frequency Allocation for ITS – The Second Phase Started

The CEPT has now done all the studies to provide the technical basis for the ITS frequency allocation at 5.9 GHz with the following results:

Within 30 MHz in the range from 5,875 – 5,905 GHz compatibility with all other services and applications is achieved with a limitation of the unwanted emissions below 5850 MHz and above 5925 MHz in order to protect other services in these bands. Within the 30 MHz protection of ITS could technically be considered and this sub-band provides a good opportunity to initiate ITS implementation.

Within 20 MHz in the range from 5,905 – 5,925 GHz the limitation of unwanted emission should also be applied and ITS may suffer interference from the Fixed Services operated above 5,925 GHz. Thus protection of this band will not be possible and the use of this sub-band for ITS would require very careful frequency planning for Roadside Units etc.

In the band from 5,855 – 5,975 GHz requested for non-safety related applications ITS may suffer interference from existing applications and

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### Workgroup Physical Layer / Mac / Net

by Andreas Festag

Workgroup Net as one of the first active workgroups started with a clear and appealing vision: A car exchanges data with other cars and road side units, either within the car's vicinity or even over larger distances. If two communicating cars are out of their direct radio range, intermediate cars will forward the data and route the packet to the destination.

The technology for communication in decentralized and self-organizing networks with mobile nodes, Mobile Ad Hoc Networks (MANETs), has been a subject of research for a number of years. In contrast to MANETs, CAR 2 CAR has specific additional requirements. The high speed of the network nodes results in frequent changes in the topology and prevents the application of a ready-made MANETs routing protocol.

The workgroup Net has adopted and enhanced a novel approach for geographical routing in Vehicular Ad hoc Networks (VANETs). This approach permits scalable wireless multi-hop communication with dynamic topologies, for unicast and - especially important - for broadcast in a defined geographical area, called geocast.

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### Workgroup Security

by Hans-Jörg Vögel

Early on in the discussions on security in the C2C-CC, some principal business requirements have been agreed that are still holding up:

- security must ensure trustworthy information exchange among vehicles as well as between vehicles and road side units to ensure dependable operation of safety-critical applications
- security does not need encrypt information, as in particular safety-related information should be accessible as easily as possible; of course, when engaging into bilateral and private transactions, confidentiality should be foreseen, in particular for transactions of a financial nature (cf. e-commerce).
- while not entirely relying on encryption, security in the C2C-CC nevertheless must ensure, that privacy of an individual is respected, i.e. a C2C-CC system must not have a negative impact on the driver's privacy.
- legal and regulatory standards must be met.

From these early and rough requirements, work progressed in two directions, a technical and a non-technical direction, both guiding and feeding each other. On the technology side,

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## Summary:

**First Security Workshop**

by Matthias Gerlach

The first open C2C-CC Security Workshop took place on 16.11.2006 in Berlin. 50 participants enjoyed interesting presentations and vivid discussions both in the plenary and in private conversations. The workshop was jointly organized by the C2C-CC Security Working Group, and the SEVECOM Project. The workshop laid the foundation for follow-up workshops both open to the public and private C2C-CC meetings.

Presentations in the first part of the workshop gave status updates with respect to the C2C-CC APP group and the C2C-CC NET/MAC/PHY group and the status of security in the United States. Further, the security requirements for a CAR 2 CAR system have been presented. The second part of the workshop featured architecture proposals from different projects, namely the SEVECOM project, the HIDENETS project, the Network on Wheels project and the EASIS project. The major security requirements for the C2C-CC security system are trust in the correctness of communicated data and user privacy protection. At the same time, the performance of the system shall not be affected, e.g., by extensive use of time-consuming verification algorithms.

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## Summary:

**First Simulation Workshop**

by Cornelius Menig

It was the first time that the CAR 2 CAR Communication Consortium and the EU-funded project COMeSafety invited to a simulation workshop – and the response was immense. More than 50 participants representing universities and research institutes, car manufacturers and tier ones, projects and consortia, simulation tool and model developers, came to DLR at Braunschweig. The DLR did a great hosting with an very interesting evening reception in their driving simulation hall. In four sessions there were thirteen presentations. Unfortunately the workshop was planned as a one day event, even though there would have been content for at least two days.



Figure: Participants of the Simulation Workshop

Why do we need CAR 2 X Communication, why do we need simulations of CAR 2 X Communication, why do we need a workshop talking about simulations of CAR 2 X communication?

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**Related Project Information: PReVENT WILLWARN** by Gerhard Nöcker

After 3 years of successful research work PReVENT WILLWARN (Wireless Local Danger Warning) ended in January 2007.

**WILLWARN partners:**

DaimlerChrysler (subproject leader),  
BMW, HTWForgis, CNRS, TNO, NTUA and Philips

**Objectives:**

WILLWARN - Wireless Local Danger Warning - supports the driver in safe driving by inter-vehicle communication and enables an electronic safety horizon for foresighted driving. To fulfil this task the following modules were developed:

- on-board hazard detection (obstacles, reduced visibility, bad road conditions,...) based on data from the vehicle buses
- a Road Side Unit (RSU) transmitting hazards from construction sites
- a warning management that takes care of low equipment rates and determines how long and how far messages are transported in the car (application based routing, store and forward)

- decentralized distribution of warnings and incident messages by adhoc car to car communication
- position based relevance check by comparison of vehicle position and the position trace leading to the dangerous spot
- early driver warning by a graphical display and warning sounds only if the driver is on the dangerous path

WILLWARN uses available low cost communication and positioning equipment. It is designed for rural road and highway scenarios and provides a high benefit for the driver even at low equipment rates.

**Results**

A wireless local danger warning system has been developed as a complete application. The results met the objectives. A modular design allowed establishing the WILLWARN function on different cars using different hardware and software platforms.

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**Interesting Events****CAR 2 CAR Forum**

the first event of the annually forum for all active and basic members to provide and discuss the latest consortium news

Ingolstadt, Germany

22nd to 23rd May, 2007

<http://www.car-2-car.org>

**6th European Congress and Exhibition on Intelligent Transport Systems and Services in Aalborg, Denmark**

18th-20th June, 2007

<http://www.itsineurope.com>

**ITS Congress in Beijing 2007**

The 14th World Congress for Intelligent Transportation Systems

Beijing, China

9th to 13th October, 2007

<http://www.itsworldcongress.cn>

**3rd International Workshop on Vehicle Communications in Beijing, China**

Vehicle-to-Vehicle and Vehicle-to-Infrastructure Communications for Safety and Efficiency

<http://www.comesafety.org>

**IP PreVENT Exhibition**

Experimental vehicles demonstrating high-tech integrated in-vehicle safety applications

18th to 22nd September, 2007

Versailles, France

<http://www.prevent-ip.org>

**Imprint**

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## At a Glance: The CAR 2 CAR Communication Consortium by Rudolf Mietzner

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Why own frequencies? Well the most used frequency for WLAN is at 2.4 GHz. This is one reason why the transmission of safety critical data is unsuitable for these frequencies. The Data that has to be transferred can be divided into three groups.

1. Critical Safety Applications: direct Vehicle – Vehicle ad hoc interface for transmitted data that are of temporal and in regard to its content – critical information. These pieces of information may save lives in some cases.
2. Safety and Traffic Efficiency: Also important but not comparable to Cat. 1.
3. Comfort and Entertainment Applications

The reason why own frequencies are indispensable for safety critical applications is to avoid interference with other systems and to provide reliable information with low latency. That may handicap the velocity and accuracy of the transferred data.

The data concerning Safety and Traffic Efficiency are to be transmitted on frequencies above

as well as below the spectrum of Critical Safety Applications. On the contrary the Entertainment and Comfort Applications are to be transmitted by WLAN, GSM and UMTS. This is only an example of the work resulting from the Consortium, in order to set the tracks for the future.

### The idea of CAR 2 CAR Communication

The Vehicle - Vehicle Communication will widen the perception range of its driver. He will know of dangers that lie invisibly behind the next bend, regardless of whether it's a broken down car or a traffic jam even aquaplane risks. It can predict - happenings and receives decisive information in real time and is therefore quicker and more agile than a vehicle without CAR 2 CAR Communication.

Conventional Sensors, like the ones already implemented today, are very useful in these cases e.g. in Driver Assistance Systems, but with restricted capabilities. They may register or detect other vehicles in their surrounding area but are unable to recognize not visible dangers. These vulnerabilities within the safety system will be

corrected by CAR 2 CAR Communication. Further more it may be also used to manage traffic flow. Drivers will receive recommendations concerning speed and distance to be kept to the car in front, to ensure a safe and fluent movement of traffic. This will avoid unnecessary braking that provokes Stop and Go Traffic.

An efficient CAR 2 CAR Communication will therefore not only improve the traffic flow but also improve the environment.

The Commission of the European Union determined that about half of the fuel consumption is due to incorrect driving behaviour, the same pattern can be seen as far as CO<sub>2</sub> emissions and particulate matter.

Prototypes already exist! The first experiment will be launched in 2008 at the latest. Its still a long way to series manufacturing but today one is working on the foundation to, on a long term, be capable to cope with the challenges ahead concerning growing traffic, the closely related safety requirements, traffic performance and environmental issues. In order to, at the end of the day, ensure the individual mobility.

## Frequency Allocation for ITS -The Second Phase Started

by Dieter Seeberger & Sören Hess

### ► SEQUEL OF PAGE 3:

mitigation technologies like Listen Before Talk are required to avoid interference to other applications.

The main conclusions are summarized in the following figure:

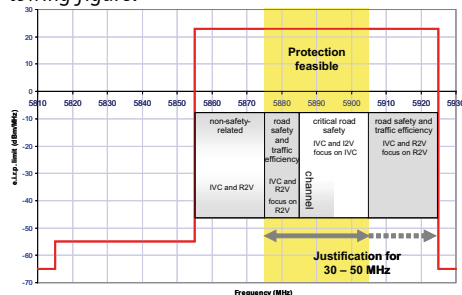


Figure: Results of spectrum engineering working group A CEPT assessment of the justification of the requested bandwidth for safety related applications concluded that 30 to 50 MHz is necessary

for safety relates applications including critical safety applications.

Based on all the technical information WG FM started consideration of a proper regulatory instrument to designated spectrum and to provide the required protection for ITS. After the first discussions there are good prospects for getting an ECC Decision, which is not legally binding for administrations to implement but provides the highest level of commitment available at the CEPT procedures.

In order to remedy a potential market failure it is very likely that spectrum assignment for ITS will be subject to a review process. Furthermore the risk of unused frequency allocations may be reduced by limiting the spectrum designation for safety related ITS applications to 30 MHz with the option for enhancement at a later stage, when ITS is successfully implemented

and more spectrum is required due to market requirements.

The CEPT provided the requested interim report in response to the EC Mandate on harmonised radio spectrum use for safety critical applications of ITS in the European Union to Radio Spectrum Committee of the EC. This report considers the new spectrum request at 5,9 GHz as well as the already available allocation from 63 to 64 GHz. Both bands are presented to be complementary due to the different radio wave propagation, technology concepts and type of applications. The final report is expected by the end of this year. Based on this report the EC should develop an EC Decision creating mandatory implementation of harmonised spectrum for ITS in the European Union.

## Physical Layer / Mac / Net

by Andreas Festag

### ► SEQUEL OF PAGE 3:

Focussing on safety as one of the main topics of CAR 2 CAR, the workgroup Net forges a tailored solution for safety applications. Typically, a safety application either sends periodical status information (geo-position, speed, and heading) on a single hop to the neighbors, or disseminates information about safety events as geocast. Both types of data traffic will be op-

timally supported by smart mechanisms, e.g. transmit power control, packet scheduling, and enhanced forwarding schemes.

Up to now, the workgroup Net has accomplished an intermediate step - basic technical requirements are assessed and communication principles fixed. The following discussion will induce a new phase and step into details for algo-

rithms and protocols. Eventually this phase will breed to a mature protocol specification. Concrete technical issues need to be tackled. Key words are multi-channel operation, congestion control, data security, privacy, integration of Internet protocols, and reliable data transport. In many cases the best current practice will be adopted and will quickly yield a satisfying technical solution.





## Workgroup Security

by Hans-Jörg Vögel

### ► SEQUEL OF PAGE 3:

some baseline concepts have been drafted, that are currently being actively discussed:

- as vehicles equipped with a C2C-CC system will be periodically geo-broadcasting their position and send beaconing information for network layer purposes, the real identity of the vehicle will be concealed to protect privacy against both, malicious and casual observation or tracking. This means, that permanent identifiers and addresses must not be communicated in clear over the air. To the contrary, at all layers from physical to IP/network to application, C2C-CC in-vehicle systems will be using temporarily assigned identifiers. Fixed identifiers should only be used in the occasional situation, where mutual system authentication is necessary, e.g. when obtaining a new set of temporary identifiers.
- to ensure trust in messages, they have to be signed. Signing of messages again has to happen with dynamically assigned, temporary pseudonyms. It is currently under investigation, how frequently pseudonyms

will be updated and what the technical mechanisms will be for this procedure. Moreover, it is yet to be decided, which crypto-technology to actually use for these pseudonym signatures. In this choice, a number of factors has to be balanced, such as security level, size of signature and bandwidth constraints, processing time and real-time requirements of e.g. safety applications. Currently, RSA and ECC are candidates under investigation. Also, process aspects such as which organisation will have authority to issue, verify and withdraw pseudonyms are critical and have to be addressed.

On the non-technical side, challenging questions will have to be addressed before being able to even draft applicable security mechanisms.

- What are the business models involved in C2C-CC systems and which business objects need to be protected against which attacks?
- What are the operational concepts and who will deploy, operate and control the infrastructure?
- Who will issue subscriber modules, if any?

When subscriber modules will be issued, how do they differ from e.g. the GSM SIM? What relationship will C2C-CC systems have with mobile networks, operators, service providers and MVNOs? Are there potential synergies, e.g. on the infrastructure side, that should be exploited when designing C2C-CC security mechanisms?

- What regulatory and legal aspects should be foreseen in the future and should be taken into account?

Recently, a working group in the eSafety Forum was established focussing on eSecurity for eSafety systems. WG SEC will be in discussion with this group, in particular also for these non-technical questions. A first introduction will happen during the first CAR 2 CAR Forum, when Andre Seeck from the German BAST, head of the German eSecurity national mirror group, will give an introduction to its agenda.

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## First Security Workshop Summary

by Matthias Gerlach

### ► SEQUEL OF PAGE 4:

The proposals for trust establishment included the use of digital certificates, in particular related the efforts in WAVE (Wireless access for vehicular environments, IEEE trial use standard 1609.2) and a public key infrastructure, and the use of plausibility checks that can detect false data. Security architectures focused on modularity and configurability of security modules within the different layers of the C2C-CC protocol stack. Issues were integration with existing

solutions from 2G/3G, the cost for setting up security infrastructures, in-vehicle security approaches, and the need for privacy for vehicular communications.

Open issues have been identified in the field of legal aspects, business requirements, design guidelines and the environment for a security solution in vehicular communications. It has been agreed that C2C-CC Security group publishes a white paper to describe and address these open issues to first identify and then foster a discus-

sion with the different stakeholders involved in CAR 2 CAR Communication. Workshop material, such as the presentations and a workshop summary can be found on the SEVECOM website.

<http://www.sevecom.org>

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## First Simulation Workshop Summary

by Cornelius Menig

### ► SEQUEL OF PAGE 4:

CAR 2 X Communication is one of the most promising technologies to make traffic in future safer and more efficient. It became very clear throughout the workshop, that a lot of different views can describe CAR 2 X Communication. According to this also different aspects of CAR 2 X Communication have to be simulated. There is always the driver view and the view of a public authority, experiencing the applications and their effects differently. You can look at it in a technological way, discussing protocol stacks, and communication ranges, etc.

The goals can be either to improve an application or a communication standard, or to measure the effects of a given system to support de-

terminations of stakeholders like car manufacturers, road operators or public authorities.

It is a critical point to mention, but at the moment these views and thus the results of the work done is not compatible. At the moment it is difficult to compare and validate results of different simulations or bring expertise from different views together.

The often mentioned - or better say dreamed of - ultimate simulator, which is able to simulate in every detail all aspects of a scenario from the driver over to the vehicle dynamics, complete protocol stacks, physics of communication, application details in every vehicle etc., is unlikely to come in the near future. This statement was not only once heard in the plenum. But where is the idea of explaining a problem without giv-

ing a possible solution. And of course the workshop participants were aware of this and so came up with two solutions perfectly fitting together. You don't need to have the ultimate simulation, if you have common interfaces for exchange. Therefore you need common use cases, common scenarios etc. known to all simulation projects and used by all simulation projects and you need a cooperation platform for doing this exchange. If you think of this platform as a project, the combination of these solutions comes into view: You have a project working out common interfaces and if the project consortium is broad enough, this is also the platform for the exchange of results, models, tools etc. The mixture of participants of the simulation work-





shop would be perfect for this kind of project, with researchers, developers, car industry etc. Knowing this, it was not a surprise that in the end with guidance of the General Manager of the CAR 2 CAR Communications Consortium Rudolf Mietzner a peer group found together, which will

prepare this project. It is not an exaggeration to mention that the cooperation of projects in matters of simulation already started during the workshop.

More Information about the Simulation Workshop, sessions and presentations are available

on the COMeSafety Website:  
<http://www.comesafety.org>.

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#### Other Projects: **PREVENT WILLWARN**

by Gerhard. Nöcker

#### ▶ SEQUEL OF PAGE 4:

The following results were achieved:

- A new and simple method for friction detection was developed.
- A fast and reliable relevance check method ensures that only drivers on the critical path are warned.
- Hazard warning management and message routing was integrated in the application layer and enables warning transport by store and forward as well as in ad-hoc networks. In the network layer of the radios the NoW-router was used. NoW – Network on Wheels is a German funded project tackling ad-hoc networking.
- During the project run time frequency allocation successfully passed first milestones. It is important to have a dedicated frequency range for safety applications in the near future to enable market introduction.
- Although validation is not easy for a distributed system like WILLWARN, an appropriate approach was found. The WILLWARN system which consists of an application distributed in a few cars and a RSU was cut into logical pieces. All parts and subsystems were successfully validated.
  - Hazard detection algorithms, especially for friction detection proved their expected performance in many tests on ice and snow.
  - Position detection by GPS and position relevance check by comparing the own position with the received critical path have been tested on all types of roads, even in complicated topological situation. The tests showed that in most cases the GPS quality is sufficient.
  - The communication hardware, which was used for WILLWARN was bought off the shelf and antennas and cable length were not optimised. Nevertheless static and dynamic range measurements proved that a range between 350 to 500m is available. Full function tests showed that this is sufficient for the WILLWARN function
  - Full system tests were carried out to evaluate the performance of warning dissemination in a vehicle network. The dry-run and the final demo showed proper operation of the system.
  - Acceptance studies based on questionnaires and a driving simulator experiment were carried out in PREVENT INSAFES. These studies

proved that the focus of WILLWARN is right and they verified the assumption on the expected driver behaviour. Early hazard warnings lead to early speed reduction and enable a safe approach to the dangerous spot.

#### Final demo

A successful final workshop was carried out at Boeblingen on Nov. 15th. WILLWARN results were presented in a vehicle demo on a street network nearby the DC office. Visitors were the PREVENT Management team, the responsible EU officer Mrs. Holmberg, and other PREVENT Subproject Leaders. The road demo including 6 cars, an obstacle car, and a Road Side Unit showed the hazard warning dissemination by WLAN communication in a dynamic vehicle ad-hoc network.



Figures: Test cars on parking place and Road Side Unit.

A Demo Graphic User Interface visualized the Hazard database of the surrounding in all cars and showed the operation of the Warning Message Management.



Figure: Graphic User Interface

The hazards were marked by an obstacle car with emergency flashers switched on, a foggy area marked by a sign where drivers switched their fog-lights on, a construction site area simulated by the RSU, and a stretch of slippery road close to an earth dump, where drivers pushed a but-



Figures: Obstacle car and foggy area

Each message contained the hazard type and a position trace. The position of the cars was compared continuously with the received traces and drivers were warned early before they approached the hazardous spots by the WILLWARN HMI.



Figure: Example of WILLWARN HMI

WILLWARN will contribute to the PREVENT exhibition in Versailles in Sept. 2007, where a similar demo is given.

PREVENT WILLWARN shows that communication is the next step and the right way for improving traffic safety in the future. WILLWARN will be among the first use cases of inter-vehicle communication.

#### Future work

Nevertheless there is some work left for the future. Field test in a larger scale than in WILLWARN should study effects of ad-hoc networks with more communicating cars. Hardware integration should be another focus. The next generation of systems should be based on micro-controllers or at least on Car-PCs. HMI and driver behaviour should be investigated further. Optimal timing for early warnings is necessary for customer acceptance. Other behavioural effects like risk compensation have to be studied. The WILLWARN application and the experience gained within the last 3 years will be taken to follow-up activities by the project partners. WILLWARN is one of the use cases specified in the CAR 2 CAR Communication Consortium. More Information available on the PREVENT Website:  
<http://www.prevent-ip.org/>

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