WIREALMATICS – WIRELESS REAL-TIME COMMUNICATIONS FOR TELEMATICS APPLICATIONS

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The WIREALMATICS project (Wireless Real-Time Communications for Telematics Applications) provides an opportunity for a recent PhD graduate to do research in close collaboration with industry. The main research goal is to enable wireless communications that meet the requirements from applications involving cooperating vehicles, but the project should also enable the graduate to do research in the more general area of wireless real-time communications as well as increase the interaction between industry and academia.

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1. Background and Motivation

The increasing requirements on vehicles regarding quality, dependability, safety and functionality calls for an integrated approach where the different subsystems of the vehicle communicate. In order to reach the goal formulated by the European commission of halving the number of road deaths by 2010 when, at the same time, traffic volumes are expected to double, additional efforts are needed to optimize the vehicle systems in relation to the road and communication infrastructure. This optimization will be realized by connecting the vehicle subsystems to road side systems and the different communications networks being built concurrently with the road infrastructure. Due to the many different requirements regarding safety, functionality, quality and environment imposed on these types of systems it is crucial that the communications architecture is well thought-out and constructed based on careful evaluations.

Reliable wireless real-time communications is a core component in CERES for enabling cooperating embedded systems.

2. Problem formulation

The wireless communications protocols available on the market today enables either reliable communications with low error rate or time critical communications with real-time constraints - but not integrated high levels of both. In order to enable increased active traffic safety by cooperating vehicles it is of utmost importance to develop efficient wireless communications protocols for critical real-time communications with requirements on reliable transfer with low error probability.

3. Approach

By formulating critical real-time constraints as so called "Quality-of-Service" (QoS) parameters they can be quantified. To solve the problem of enabling reliable wireless real-time communications an integrated approach is needed. The latest advances and cutting edge technologies in channel coding and retransmission protocols in the lower layers of the communications stack need to be tailored to the increased requirements of the emerging applications in the upper layers. Design of retransmission protocols and channel coding with

different QoS constraints is a relatively new research area, but everything indicates that the applications requirements should be allowed to influence and imbue all layers in the communications stack in order to make the best use possible of the limited resources available in a wireless network.

Figure 1. Traditional telematics applications imply communication between truck and back-office.

The purpose of this project is to allow the application requirements, formulated as QoS parameters, to control the lower layers of the communications stack to enable the development of efficient time critical communication protocols for future mobile wireless networks. Longer term this project has the potential of playing a fundamental role in the implementation of many future intelligent transport services.
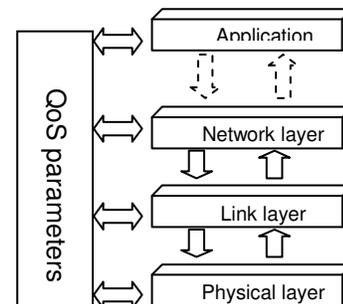

Figure 2. Cross-layer design based on QoS parameters set by the application.

4.   Results

Two master thesis projects on wireless vehicular communications have been conducted at Volvo Technology under the supervision of Dr. Uhlemannn, CERES and Mr. Nygren, Volvo Technology. The thesis "Collaborating Vehicles for Increased Traffic Safety" by I. Khalil and M. Morsi has been awarded with the Triona and WSP scholarship given to the best thesis related to the ITS field. A chapter of the thesis "Test Environment Design for Wireless Vehicle Communications" by P. Lerchbaumer and A. Ochoa Lopez has been accepted for publication at the IEEE International Symposium on Wireless Vehicular Communications.

Katrin Bilstrup, CERES Ph.D. student, is investigating medium access methods suitable for providing real-time communication in an *ad hoc* vehicular network. Ms. Bilstrup has several times been invited to Volvo Technology to give seminars, provide technology expertise and convey her research results on this topic.

Close collaboration has been established with the European IP project CVIS (www.cvisproject.org), Chalmers vehicle and traffic safety center SAFER (www.chalmers.se/safer/) and the COST Action 2100 (www.cost2100.org).

Dr. Uhlemann is doing research on wireless real-time communications guided by QoS parameters from several different applications in both vehicular networks, *ad hoc* networks and wireless sensor networks.

PARTNERS AND STATUS

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Project leader: Dr. Elisabeth Uhlemann

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