

## Challenges in Vehicular Connectivity for Intelligent Transportation Systems

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Future vehicles tend to increase their capabilities to connect wirelessly to a large variety of services. The connected vehicle's vision aims at an efficient utilization of resources in wireless communications to provide advanced functionality in infotainment-, traffic efficiency and safety to the driver. The vehicle itself – embedded in an IP based communications infrastructure – furthermore leverages the potential to exchange on-board sensor information with the Cloud to enable advanced applications in personalized mobility. Such concepts require context-aware and proximity-enabled access to wireless services. This calls for scalable wireless connectivity with sufficient bandwidth, robustness and latency. Therefore, next-generation communications techniques and networks for automotive use-cases are currently being researched intensively. Herein, cellular networks like the 4G Long Term Evolution (LTE) and ad-hoc based communications like ETSI ITS G5 are of prime interest to the automotive industry. Heterogeneous communications incorporating cellular- and ad-hoc radio access with transparent routing protocols provide a scalable and improved service delivery and will promote the market introduction for advanced Vehicle-to-X applications.

This paper summarizes some of the key challenges in vehicular connectivity with focus on 4G LTE and ETSI ITS G5 communications. Considered aspects include propagation effects of the vehicular wireless channel, automotive antenna elements as well as on-board electronics and architectures. It will be shown that the antenna system as an interface between propagation channel and vehicular on-board unit exceptionally defines the performance of the related applications. In order to solve the requirements of mounting concepts for automotive antenna equipment, antenna design for Vehicle-to-X applications remains an ongoing challenge.

### Biography – Dr. Oliver Klemp



**Oliver Klemp** received his Dipl.-Ing. degree in 2002 and the Dr.-Ing. degree in 2007 (with distinction), both in Electrical Engineering from Leibniz University of Hannover. His principal research interests included antenna systems and electronics for MIMO wireless communications, signal processing in multiple antenna configurations and ultra-wideband communications. Dr. Klemp joined Delphi Delco Electronics Europe GmbH in 2006 as a research engineer for antennas and receivers in the area of digital satellite radio systems. From 2007 through 2010 he worked as a product line architect and project manager in advanced engineering and series development with focus on antennas and

transceivers for Vehicle-to-X communications and automotive infotainment systems. In 2010, Oliver Klomp joined BMW Group Research and Technology as a research specialist in the area of vehicle-centric communications with focus on Intelligent Transportation Systems (ITS).

From 2007 through 2011 Dr. Klomp also held a position as an external lecturer for electromagnetic wave propagation and RF circuits and systems at the Institute of High Frequency Technology and Radio Systems at Leibniz University of Hannover.

Dr. Klomp was awarded with a Gerotron Innovation Award in 2005 and is the recipient of the Scientific Award of the City of Hannover in 2008. He has authored or co-authored more than 50 papers in international journals and conferences and is co-author of the COST 2100 book "Pervasive Mobile and Ambient Wireless Communications". Oliver Klomp is a member of the IEEE, the German Electrotechnical Association (VDE), COST IC 1004 and the Car-2-Car Communication Consortium.