Vehicular Networks Workshop at GLOBECOM 2015

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With the increasing prospects of deploying vehicular networks, there are challenges and debates. Viable deployment models, different air interfaces, spectrum sharing issues and security and privacy concerns are among the most topical issues of industry debate. The recent Vehicular Networks Industry Workshop at IEEE GLOBECOM 2015 surveyed current opportunities and challenges with vehicular networks. Presentations described the near-term opportunities for deployment, not only with Dedicated Short Range Communications (DSRC) but also with evolving concepts in LTE, spectrum sharing across unlicensed technologies, up to and including 5G. Other topics included network security and privacy issues, current research in network simulation, vehicular cloud computing and vehicle telematics.   This was the fourth Vehicular Networks program I have hosted at GLOBECOM. Previously workshops (2007-2009) had focused primarily on the technology of Dedicated Short Range Communication (DSRC/802.11p) and the emerging IEEE 1609 standards for Wireless Access to Vehicular Environments (WAVE). This year's program was attended by twenty-five international members of industry and academia and featured 6 speakers at the workshop, including

Walton Fehr is a US DOT engineering professional with extensive experience in a wide variety of engineering and marketing roles in the automotive industry, including electronic component design, technology introduction, and business development. Specialties include leading multi-discipline engineering teams, designing products for rigorous automotive applications, and transferring technology from Internet and telecom into automotive.

Dr. John B. Kenney is Network Division Director and Principal Researcher at the Toyota InfoTechnology Center in Mountain View, CA. He leads a team researching vehicular communication, including DSRC, Automated Driving, and Smart Grid. His personal research focuses on performance and standardization of DSRC, especially channel congestion control and spectrum sharing.

Jim Misener, Director, Technical Standards at Qualcomm Technologies, Inc., leads Qualcomm's international automotive standardization efforts.   Mr. Misener is Chair of the SAE Dedicated Short Range Communication Technical Committee and a member of the IEEE P1609 Working Group. He is also the US Expert in ISO TC/204 WG 17 (Nomadic Devices) and WG 18 (Cooperative ITS).

Dr.. Tao Zhang joined Cisco in 2012 as the Chief Scientist for Smart Connected Vehicles. Since then, he has also been developing architectures and strategies for Internet of Things and Fog Computing. Prior to joining Cisco, he had been Chief Scientist and Director of Mobile and Vehicular Networking at Telcordia Technologies. He was elected a Fellow of the IEEE in 2010. Dr. Zhang is author of Vehicle Safety Communications: Protocols, Security and Privacy (Wiley 2012).

Dr. Weidong Xiang is an Associate Professor at University of Michigan, Dearborn (UMD) where his research interest includes vehicular communications and networks, ultra-wideband (UWB), wireless networked control systems, Internet of Things and wireless positioning. He established and leads the Center for Vehicular Communications and Network Laboratory at UMD. Dr. Xiang is

author of Physical Layer Technology for Connected Vehicles (Springer)

Dr. Falko Dressler is a Full Professor for Computer Science and head of the Distributed Embedded Systems Group at the Dept. of Computer Science, University of Paderborn. He is an editor for journals such as IEEE Trans. on Mobile Computing, Elsevier Ad Hoc Networks, Elsevier Computer Communications, and Elsevier Nano Communication Networks. Dr. Dressler is author of Vehicular Networking (Cambridge University Press 2015)

Highlights of the GLOBECOM 2015 Vehicular Networks workshop

Summaries of the workshop presentations are given below along with web links to the discussion slides.

● **Dedicated Short Range Communication (DSRC) - Ready for Prime Time (Walton Fehr - US DOT)** The US Department of Transportation (US DOT) Connected Vehicle program has updated the Connected Vehicle Reference Implementation Architecture (CVRIA) and launched pilot programs to deploy DSRC In three major US transportation corridors (ICF/Wyoming, Tampa (THEA).

● **5.9 GHz Spectrum Sharing - (John Kenney - Toyota ITC)** - In May 2015, US DOT released a DSRC Spectrum sharing plan designed to share the section of the radio spectrum reserved for vehicle safety applications such as vehicle-to-vehicle and vehicle-to-infrastructure communications for the DSRC, 5850–5925 MHz spectrum band.   Dr. Kenney presented options available to the Wi-Fi community to let them share the spectrum on the condition that they cause "no harmful interference" to DSRC.

● **Is there LTE in V2V? (Jim Misener - Qualcomm)** – This session addressed the access technologies that are currently available and that may be available in the coming decade: DSRC is of course a necessary and primary aspect of this mix, but there are in various parts or this world emerging research and standardization activities that envision LTE expansion into "LTE V2X" and a pan-European "5G Automotive Vision".

● **Why We Need a New Paradigm for Securing the Internet of Vehicles (Tao Zhang)** - Two fundamental questions are addressed in this presentation 1) what security challenges in connected vehicles in particular and in IoT in general are so unique that they cannot be adequately addressed by the existing security paradigm? and 2) what fundamental changes to the existing security paradigm will be needed to address these new challenges?

● **Research and Prototyping Activities of DSRC at the University of Michigan (Weidong Xiang)** – Dr. Xiang presented current research and prototyping of DSRC systems covering related areas ranging from channel modeling, baseband algorithms, prototyping and vehicular network simulator, system level channel emulator and field testing. Also presented was the Mobile Transformation Center (MTC) Pillar Project at the University of Michigan, which is establishing a citywide connected vehicle infrastructure with up to 9,000 vehicles to cover the city of Ann Arbor, MI, the largest infrastructure under development of its kind worldwide

● **Towards the Vehicular Cloud (Falko Dressler)** – Dr. Dressler presents the connected cars vision in relation

to some of the most needed components in modern smart cities: improved road traffic safety combined with reduced travel times and emissions. Using selected application examples including the use of virtual traffic lights, intelligent intersection management, and platooning, he presents the needs on the underlying system components with a particular focus on inter-vehicle communication and the potential of the vehicular cloud based on the example of parked vehicles providing a model for storage infrastructure.

Comments on the Vehicular Network program

As a practitioner, writer and sometime educators in the field of Vehicular Networks this workshop presented a 'quantum leap' forward in my understanding of the communication technologies, research and commercial solutions that have emerged in the field.   Only a few years ago (2011) I was a contributing author to the seminal paper "Vehicular networking: A survey and tutorial on requirements, architectures, challenges, standards and solutions" (Karagiannis, et al) for IEEE Communication Surveys and Tutorials (a fine on line publication).   At the time of that study, DSRC seemed like the only game in town and research was still primarily focused on prototypes and trials for the WAVE protocol stack.   F   ograms, the Connected Vehicle pilot programs were still emerging and much of the resea   ed from the earlier US DOT VII/Intellidrive programs.

Fast forward to San Diego this year and the ecosystem of Intelligent Transportation Systems for Automotive Networks now presents a variety of communication protocols (DSRC, LTE, emerging 5G and cloud-based options).   In particular, I would point to "Inter-Vehicle Communication – Quo Vadis" (Dressler, et al), and "Heterogeneous Vehicular Networking: A Survey on Architecture, Challenges, and Solutions" as excellent research pointing to the mixed-mode operation of operational and deployable systems. The challenges and opportunities for Security Architectures in this field remain (as Dr. Tao Zhang suggested) beyond "the firewall garden" and headed quickly towards a model based on ubiquitous communication structures as presented by IoT. An excellent discussion on this topic is the research on "The Fog Computing Paradigm: Scenarios and Security Issues" (Stojmenovic/Wen) which analyzes threats and defense in a mixed-mode Vehicular Network communication system.

I would like to thank the presenters and attendees at this year's GLOBECOM workshop on Vehicular Networks. My hope is that the interest and momentum from these presentations will continue in the conference program over the next few years.   In particular, I would encourage a group of CISTC members to carry this topic forward in this year's meetings and publications.   Finally, this brief summary of important research in Vehicular Networks has been included in my SecurityFeeds industry portal – Secure Automotive Networking for ITS. Over the past ten years I have maintained this aggregation website as a gateway to national and international Vehicular Networking pilots, standards, research, publications and commercial products.

Author bio:

Tim Weil is a Senior Member of the IEEE and Security Editor for IT Professional magazine. In the areas of Vehicular Networks his work includes the IEEE 1609 (WAVE) standards, US DOT VII/Intellidrive and Connected Vehicle programs, author and speaker on topics in Security for Vehicular Networks. His interests include "Service Management for Vehicular Networks Using WAVE

(IEEE 1609) Protocols" and topics related to the PKI models for implementing IEEE 1609.2 (WAVE Security). Mr. Weil is an industry-certified security professional (CISSP, CISA, PMP) and chair of the IEEE Denver Communication Society Chapter. He can be reached at trweil@ieee.org.