Preface

The Communication Technologies for Vehicles workshop series provides an international forum on latest technologies and research in the field of intra- and inter-vehicle communications in which to present original research results in all areas relating to communication protocols and standards, mobility and traffic models, experimental and field operational testing, and performance analysis.

Previous Nets4Cars workshops were held in Saint Petersburg, Russia (2009) and in Newcastle, UK (2010). These proceedings contain the papers presented at the Third International Workshop on Communication Technologies for Vehicles (Nets4Cars and Nets4Trains 2011), which for the first time had dedicated tracks for road- and rail-based approaches and took place in Oberpfaffenhofen near Munich, Germany, in March 2011.

Our call for papers resulted in 34 submissions, 13 for the rail track and 21 for the road track. Each of them was assigned to at least four members of our outstanding Technical Program Committee with specific expertise in the field. After a double-blind review process in just 2 weeks and some online discussion on boundary cases, the Program Committee Co-chairs selected 19 full papers for publication in these proceedings and presentation at the workshop, 7 of them for the rail track and 12 for the road track. In addition, one invited paper was accepted from a strong industrial stakeholder in the rail track who also gave the keynote. The order of the papers in these proceedings was aligned with the workshop program.

We extend a sincere “thank you” to all the authors who submitted papers of their most recent work, to all the members of our hard-working comprehensive Technical Program Committee, as well as the thoughtful external reviewers.

March 2011

Thomas Strang and Andreas Festag,
TPC Co-Chairs

Alexey Vinel and Rashid Mehmood,
General Co-Chairs

Cristina Rico Garcia,
Rail Track Chair

Matthias Röckl,
Road Track Chair
Organization

Conference Organizers

General Co-chairs
Alexey Vinel (SPIIRAS, Russia)
Rashid Mehmood (Swansea University, UK)

Technical Program Co-chairs
Thomas Strang (DLR, Germany)
Andreas Festag (NEC, Germany)

Rail Track Chair
Cristina Rico Garcia (DLR, Germany)

Road Track Chair
Matthias Röckl (In2Soft, Germany)

Steering Committee

Axel Sikora
Duale Hochschule Baden-Wurttemberg, Germany

Tsutomu Tsuboi
Renesas Corp., Japan

Fei Liu
University of Twente, The Netherlands

Xu Li
State University of New York at Buffalo, USA

Yan Zhang
Simula Research Laboratory, Norway

Antonella Molinaro
University Mediterranea of Reggio Calabria, Italy

Marion Berbineau
INRETS, France

Juan de Dios Sanz Bobi
CITEF, Spain

Technical Program Committee

Marina Aguado
University of the Basque Country (Spain)

Onur Altintas
Toyota InfoTechnology Center (Japan)

Atif Alvi
LUMS (Pakistan)

Petros Belimpasakis
Nokia Research Center (Finland)

Marion Berbineau
INRETS (France)

Mohamed Boucadair
France Telecom (France)

Torsten Braun
University of Bern (Switzerland)

Marcello Caleffi
University of Naples Federico II (Italy)

Eduardo Cerqueira
University of Coimbra (Portugal)

Soumaya Cherkaoui
University of Sherbrooke (Canada)

Marilia Curado
University of Coimbra (Portugal)

Robil Daher
University of Rostock (Germany)

Thierry Ernst
INRIA (France)
Andreas Festag  
NEC Laboratories Europe (Germany)

Fethi Filali  
Qatar University Wireless Innovations Center (Qatar)

Francisco Garcia  
Agilent Technologies (UK)

Benoit Geller  
ENSTA (France)

Javier Goikoetxea  
Construcciones y Auxiliar de Ferrocarriles (Spain)

Javier Gozalvez  
Universidad Miguel Hernandez de Elche (Spain)

Christophe Gransart  
INRETS (France)

Oleg Gusikhin  
Ford (USA)

Jerome Harri  
EURECOM (France)

Geert Heijenk  
University of Twente (The Netherlands)

Muhammad Ali Imran  
University of Surrey (UK)

Sithamparanathan Kandeepan  
CREATE-NET (Italy)

Yevgeni Koucheryavy  
Tampere University of Technology (Finland)

Uwe Kucharzyk  
Bombardier Transportation (Germany)

Long Le  
NEC Laboratories Europe (Germany)

Andreas Lehner  
German Aerospace Center (DLR)(Germany)

Tim Leinmüller  
DENSO AUTOMOTIVE Deutschland GmbH (Germany)

Fei Liu  
University of Twente (The Netherlands)

Katrin Lüddecke  
German Aerospace Center (DLR)(Germany)

Juliette Marais  
INRETS-LEOST (France)

Rashid Mehmood  
Swansea University (UK)

Markus Miche  
SAP Research (Germany)

David Mottier  
Mitsubishi Electric R&D Centre Europe (France)

John Murphy  
University College Dublin (Ireland)

Augusto Neto  
Universidade Federal de Goias (Brazil)

Brian Park  
University of Virginia (USA)

Cristina Rico-Garcia  
German Aerospace Center (DLR)(Germany)

Matthias Röckl  
In2Soft / KPIT Cummins (Germany)

Paolo Santi  
IIT-CNR (Italy)

Divitha Seetharamdoo  
INRETS (France)

Thomas Strang  
German Aerospace Center (DLR)(Germany)

Markus Strassberger  
BMW Group Research and Technology (Germany)

Jouni Tervonen  
University of Oulu (Finland)

Ozan Tonguz  
Carnegie Mellon University (USA)

Tsutomu Tsuboi  
Renesas Technology Corp (Japan)

Bart van Arem  
TU Delft (The Netherlands)

Alexey Vinel  
SPIIRAS (Russia)

Martine Wahl  
INRETS (France)

Michelle Wetterwald  
EURECOM (France)
Christian Wewetzer  
Volkswagen Group (Germany)

Nawaporn Wisitpongphan  
KM Univ. of Techn. North Bangkok (Thailand)

Yunpeng Zang  
RWTH Aachen (Germany)

Yang Zhang  
Pennsylvania State University (USA)

**Additional Reviewers**

Robert Schmidt  
DENSO AUTOMOTIVE Deutschland GmbH  
(Germany)

Osianoh Aliu  
University of Surrey (UK)

Amin Amich  
University of Surrey (UK)

Herv Bonneville  
Mitsubishi Electric R&D Centre Europe  
(France)

Miguel Sepulcre  
University Miguel Hernandez of Elche (Spain)

**Hosting Institution**

Nets4Cars & Nets4Trains 2011 was hosted by the Institute of Communications and Navigation at the German Aerospace Center (DLR)

**Sponsoring Institutions**

German Aerospace Center (DLR), Germany
SPIIRAS, Russia
Swansea University, UK
Tampere University of Technology, Finland
# Table of Contents

## Keynote

Requirements for Wireless Technology on Rolling Stock .............................. 1  
*Uwe Kucharzyk*

## Rail Track

An Experimental Study of Multi-radio Platform Coexistence in the  
5 GHz Band for Railway Applications ...................................................... 11  
*Jorge Higuera, Elli Kartsakli, Carlos Collado,  
José M. González-Arbesú, Luis Alonso, José Luis Valenzuela,  
Andres Laya, Enrique Flores, Isabel Navarro, Raquel Martínez,  
Jesús González, José Hierro, and Adrian Vlad*

Train Tracking and Shadowing Estimation Based on Received Signal Strength ................................................................. 23  
*Hadi Noureddine, Damien Castelain, and Ramesh Pyndiah*

Delivering Broadband Internet Access for High Speed Trains Passengers  
Using an Innovative Network Mobility Solution ......................................... 34  
*Bernadette Villeforceix*

Measurement and Analysis of the Direct Train to Train Propagation Channel in the 70 cm UHF-Band ......................................................... 45  
*Andreas Lehner, Cristina Rico García, Thomas Strang, and Oliver Heirich*

WiMax’ble Pervasive Cloud – Empowering Next Generation Intelligent  
Railway Infrastructure ...................................................................................... 58  
*Subrahmanya Venkata Radha Krishna Rao and Vivek Diwanji*

The MIH (Media Independent Handover) Contribution to Mobility Management in a Heterogeneous Railway Communication Context:  
A IEEE802.11/802.16 Case Study ................................................................. 69  
*Marina Aguado, Jasone Astorga, Jon Matias, and Maider Huarte*

Multiple Description Coding and Scalable Video Coding Combined  
with Multiple Input Multiple Output Techniques: Two Strategies to  
Enhance Train to Wayside Video Transmissions in Tunnels ........................ 83  
*Imade Fahd Eddine Fatani, Yann Cocheril, Crépin Nsiala,  
Marion Berbineau, François-Xavier Coudoux,  
Marie Zwingelstein-Colin, and Patrick Corlay*
Road Track

VANET Architectures and Protocol Stacks: A Survey
Sajjad Akbar Mohammad, Asim Rasheed, and Amir Qayyum

Sebastian Röglinger and Christian Facchi

Wireless Protocol Design for a Cooperative Pedestrian Protection System
Dirk Lill, Manuel Schappacher, Shahidul Islam, and Axel Sikora

A Vehicular Mobility Model Based on Real Traffic Counting Data
Yoann Pigné, Grégoire Danoy, and Pascal Bouvry

Driver-Centric VANET Simulation
Pedro Gomes, Cristina Olaverri-Monreal, Michel Ferreira, and Luís Damas

Simulative Evaluation of the Potential of Car2X-Communication in Terms of Efficiency
Benno Schweiger, Philipp Ehnert, and Johann Schlichter

Performance Study of an In-Car Switched Ethernet Network without Prioritization
Hyung-Taek Lim, Kay Weckemann, and Daniel Herrscher

Degradation of Communication Range in VANETs Caused by Interference 2.0 - Real-World Experiment
Robert K. Schmidt, Bernhard Kloiber, Florian Schüttler, and Thomas Strang

Real-World Measurements of Non-Line-Of-Sight Reception Quality for 5.9GHz IEEE 802.11p at Intersections
Thomas Mangel, Matthias Michl, Oliver Klemp, and Hannes Hartenstein

Interoperability Testing Suite for C2X Communication Components
Fabian de Ponte Müller, Juan María Reveriego Sierra, Bernhard Kloiber, Matthias Röckl, and Thomas Strang

Towards Standardization of In-Car Sensors
Zubair Nabi, Atif Alvi, and Rashid Mehmood
Secure Automotive On-Board Protocols: A Case of Over-the-Air Firmware Updates ............................................ 224
  Muhammad Sabir Idrees, Hendrik Schweppe, Yves Roudier, Marko Wolf, Dirk Scheuermann, and Olaf Henniger

Author Index .......................................................... 239