Guest Editorial
Special Section on Telematics Advances for Vehicular Communication Networks

THE BENEFITS and enjoyment provided by personal and commercial mobility and supported by vehicular technology have enabled the automobile industry to be successful for more than 100 years. At present, there are more than 1 billion vehicles on roads all over the world, and they inevitably have a complicated impact on human society and daily life and, simultaneously, are a burden to the natural environment. In the past decade, there has been an increasing need to enhance the benefits of automobiles and, at the same time, improve passengers and pedestrians safety, as well as mitigate roadway congestion, fossil-fuel depletion, and gas emission problems. Apart from other relevant technological advances, the application of information and communication technologies to transport infrastructure and vehicles can lead to intelligent transport systems (ITS) that improve transport outcomes such as transport safety and comfort, transport productivity, travel reliability, informed travel choices, and environmental performance. Despite the recent global economic downturn, which has negatively affected the automobile industry, active research continues in this promising area, and new technical challenges have emerged that demand advanced research and rapid innovative development.

Wireless communications and networking is a core enabling technology for ITSs. A new era of cooperative systems in vehicular networking technology that builds on vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication is approaching, which is driven by both (precompetitive) public- and private-sector investments. Not only are safety-related applications taken into consideration, but nonsafety multimedia content provisioning has also become a hot topic of research and development. Among recent ITS developments, telematics techniques for transportation have shown much progress, e.g., interaction between automobiles and the infrastructure for delivering services such as roadside assistance, automatic crash notification, concierge assistance, and vehicle condition reports. Many IEEE-802.11p-variant equipment prototypes have been built, and several technical reports based on field trials have demonstrated the need for cutting-edge techniques to improve system performance. Technology and applications for ITSs and telematics design are rapidly emerging, and there is a critical need to bring together professional researchers, engineers, and practitioners from academia, industry, the private sector, and the public sector to exchange information about needs, ideas, applications, and solutions.

This Special Section, entitled "*Telematics Advances for Vehicular Communication Networks,*" focuses on the hottest issues of vehicular communication networks and telematics applications. Our aim has been to provide a venue in which both academia and industry share experiences and report original work regarding all aspects of vehicular communication, such as vehicular ad hoc networks (VANETs), information dissemination, road safety, ITSs, and emergency services. This Special Section promotes meaningful research in the cross-layer design of networking architectures, algorithms, and applications for intervehicle communication environments. The importance and timeliness of the topics covered in this Special Section have attracted much interest, and 44 manuscripts were received by January 31, 2011. After a few rounds of review, ten papers have been accepted to be included in the January 2012 issue. These papers address three essential technical challenges in vehicular communication networks. First, we have the well-known penetration rate issue: Using V2V communication for a variety of active safety-oriented applications is feasible only after a sufficient number of vehicles on the road are equipped with compatible communication technologies to communicate with one another. This issue is investigated in a few of the papers that examine V2V connectivity requirements and ways to improve system performance. The second area covered in this Special Section is how to share information among vehicles, infrastructure, and their users. Finally, the third area covered in this Special Section is on traffic flow control methods used to reduce vehicular fuel consumption.

To fulfill our role as guest editors, we would like to briefly introduce the ten papers included in this Special Section. The first topic covered in this Special Section consists of two papers. The first paper is entitled "*Performance of 802.11p Physical Layer in Vehicle-to-Vehicle Environments*," which was coauthored by Fernandez *et al.* This paper proposes a dynamic equalization scheme for significantly reducing the packet error rate during data transmission. Additionally, a field-programmable-gate-array-based hardware testbed was built to verify its implementation feasibility. The other paper is entitled "*Distributed Space-Time-Frequency Coding for Broadband Wireless Relay Networks*," coauthored by Yang *et al.* This paper proposes a class of distributed space-time-frequency codes for broadband wireless relay networks.

The second topic covered in this Special Section consists of five papers. They can be further grouped into three subareas. The first subarea addresses packet loss recovery, and this subarea is composed of two papers. One is the paper entitled "*Effect of Retransmissions on the Performance of IEEE 802.11*

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MAC Protocol for DSRC" by Hassan *et al.* This paper develops a comprehensive analytical model to predict the behavior of the distributed coordination function protocol for broadcasting V2V safety messages with and without retransmissions. The other paper is entitled "*Blind XOR: Low-Overhead Loss Recovery for Vehicular Safety Communications*," coauthored by Z. Wang and M. Hassan. This paper investigates a blind low-overhead loss recovery method for vehicular safety communications. The second subarea addresses research on V2I and V2V scheduling. This subarea consists of two papers. One is entitled "*Design and Analysis of a Robust Broadcast Scheme for VANET Safety-Related Services*," by Ma *et al.* This paper deals with the design and corresponding analysis of a robust broadcast scheme for VANET safety-related services. The other is entitled "*On the Joint V2I and V2V Scheduling for Cooperative VANETs with Network Coding*" by Wang *et al.* This paper investigates the information spread problem in a joint V2I and V2V communication system. The third subarea is mobility management. The only paper in this subarea is the paper entitled "*Performance Analysis of PMIPv6 based Network Mobility for Intelligent Transportation Systems*," which was authored by Lee *et al.* This paper introduces new network mobility support protocols that rely on mobility service provisioning entities introduced in Proxy Mobile IPv6 as possible mobility support protocols for ITSs.

The third topic covered in this Special Section consists of three papers. These papers are grouped together because they all describe value-added services or special-purpose applications. One is the paper entitled "*Pseudonym Changing at Social Spots: An Effective Strategy for Location Privacy in VANETs*," by Lu *et al.* In this paper, the authors present an effective pseudonym-changing strategy at social spots (PCS) to achieve provable location privacy. Additionally, two anonymity set analytic models are developed to prove the feasibility of the PCS strategy in practice. The second paper is entitled "*An Open Traffic Light Control Model for Reducing Vehicles* CO_2 *Emissions Based on ETC Vehicles*" by C. Li and S. Shmamoto. The third and final paper is entitled "*Reducing Greenhouse Effects via Fuel Consumption-Aware Variable Speed Limit (FC-VSL),*" which was authored by Liu *et al.* The former paper studies an open traffic light control model to reduce CO_2 emission from vehicles when electronic toll collection (ETC) assists in collecting road traffic flow data and performs calculations to recommend appropriate vehicle speeds. The latter paper presents a carbon footprint/fuel consumption-aware variable speed limit (FC-VSL) traffic control scheme that attempts to minimize the average vehicular fuel consumption on freeways. The authors formulated the minimization of fuel consumption for a specific vehicle under given traffic conditions as an optimal control problem. By solving the problem, an optimal vehicular trajectory can be obtained to lead to minimum fuel consumption. Accordingly, the FC-VSL scheme can then be designed based on the optimal trajectory.

In conclusion, this Special Section includes ten papers that cover a wide range of topics in the broad area of vehicular communications and networks and telematics applications and services. We hope that these papers stimulate new research directions and solutions that can lead to both theoretical insight and practical applications.

We thank all contributors who submitted manuscripts to this Special Section, as well as all the reviewers for their thoughtful and timely reviews. We also thank the IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY for giving us the opportunity to put this Special Section together and, in particular, Prof. Zhuang, Editor-in-Chief, for her support and guidance during the whole process.

JIA-CHIN LIN, *Guest Editor*
Department of Communication Engineering
National Central University
Taoyuan 32001, Taiwan

CHRISTOPH MECKLENBRÄUKER, *Guest Editor*
Institute of Telecommunications
Vienna University of Technology
1040 Vienna, Austria

ALEXEY VINEL, *Guest Editor*
Department of Communications Engineering
Tampere University of Technology
33101 Tampere, Finland

SPYRIDON VASSILARAS, *Guest Editor*
Broadband Wireless and Sensor Networks Group
Athens Information Technology Center for Research and Education
19002 Athens, Greece

TAO ZHANG, *Guest Editor*
Telcordia Technologies
Piscataway, NJ 08854 USA

KUEN-RONG LO, *Guest Editor*
Telecommunication Laboratories
Chunghwa Telecom Co., Ltd.
Taoyuan 32601, Taiwan