Guest Editorial
Vehicular Communications and Networks—Part II

This JSAC special issue has selected 34 papers for publication out of 124 submissions. It is devoted to reporting on cutting-edge research achievements covering various aspects of vehicular communications and networks that are distinctly different from communication networks in general. These 34 accepted papers are classified as five categories. Part I of our special issue, published in January 2011, included the first three categories of 21 papers and focused on the physical layer, MAC layer, and physical-link cross-layer design technologies. In particular, the first category was comprised of five papers focusing on physical layer aspects in vehicular communications. The second category included five papers addressing MAC layer protocols. The third category contained 11 papers, discussing cross-layer design schemes combining mainly the physical layer and link layer techniques.

Part II comprises the last two categories of the remaining 13 papers, which deal with handover, routing, security, and privacy preserving technologies. The fourth category consists of six papers, addressing handover and routing protocols. Finally, the fifth category has seven papers, dealing with security and privacy preserving technologies. In the following, we briefly discuss each of the papers in the remaining two categories.

I. CATEGORY IV: HANDOVER AND ROUTING PROTOCOLS

The fourth category of six papers is related to handover and routing protocols for solving network connectivity problems in vehicular communication networks.

The paper “Seamless Connectivity and Routing in Vehicular Networks with Infrastructure” by Annese, Casetti, Chissaroni, Maio, Ghittino and Reineri studies the joint problem of traffic delivery and connectivity management in a vehicular communication scenario with vehicles connecting to different roadside mesh nodes as they move in an urban environment. The authors propose an improved routing protocol along with a handover mechanism that allows vehicles to connect to different roadside mesh nodes in a seamless manner. The proposed routing and handover protocols are implemented in two roadside vehicular testbeds, which prove the feasibility of the solutions.

The next paper “Dynamics of Network Connectivity in Urban Vehicular Networks” by Viriyasitavat, Bai, and Tonguz presents a comprehensive analytical framework, as well as a simulation framework, for network connectivity of urban VANETs, using some key system parameters such as link duration, connection duration, and re-healing time. The analytical framework leads to closed-form expressions which capture the impact of four critical parameters (network density, transmission range, traffic light mechanisms, and size of a road block) on network connectivity. The predictions of the analytical framework also shed light on which type of safety and non-safety applications can be supported by urban VANETs.

In the paper “Optimal Distributed Vertical Handoff Strategies in Vehicular Heterogeneous Networks”, Shafiee, Attar, and Leung investigate the problem of optimal vertical handoff (VHO) decision making in heterogeneous vehicular networks in order to minimize the cost of communications or alternatively minimize the communication time. It is shown that in a heterogeneous network consisting of a cellular network and wireless local area networks (WLANs) with only vehicle-to-infrastructure (V2I) capability, use of VHO is an appropriate choice in lower speeds, while it would be better to avoid VHO and stay in the cellular network at higher speeds. If both V2I and vehicle-to-vehicle (V2V) capabilities are possible, the combination of WLAN plus cellular plus ad hoc networking outperforms any other networking strategies in terms of transmission times and costs.

Chung, Kim, Park, Choi, and Oh, in “Time Coordinated V2I Communications and Handover for WAVE Networks”, propose a time coordinated multiple access scheme, named wireless access in vehicular environment (WAVE) point coordination function (WPCF), for improved V2I communications and WAVE handover controller (WHC) for minimizing service disconnection time. The mathematical and simulation results show that the proposed scheme can significantly improve the handover latency performance compared to the existing protocols.

The paper “Dynamic Clustering-Based Adaptive Mobile Gateway Management in integrated VANET — 3G Heterogeneous Wireless Networks” by Benslimane, Taleb, and Sivaraj introduces a novel heterogeneous architecture that integrates IEEE 802.11p-based VANETs and 3G/UMTS networks. In this architecture, vehicles are dynamically clustered and a minimum number of vehicles are selected as vehicular gateways to link VANET to UMTS, considering issues such as route stability, mobility features, and signal strength of vehicles. Simulation results demonstrate the promising performance of the envisioned architecture with the proposed adaptive mobile gateway management in terms of high data packet delivery ratios and throughput, reduced control packet overhead, and minimized delay and packet drop rates.

“Cross-Layer Routing Using Cooperative Transmission in Vehicular Ad-hoc Networks” by Ding and Leung is the last paper of this group. It studies two types of cross-layer routing optimization schemes for VANETs by applying cooperative transmission and a new strategy of path selection to achieve a better tradeoff between the transmission power consumption and end-to-end reliability. The effect of cooperative transmission on the wireless link cost and consequently on the routing...
decision is studied. Analytical and simulation results show that using cooperative transmission typically yields more efficient routes than the comparable schemes in terms of end-to-end reliability and total transmission power.

II. CATEGORY V: SECURITY AND PRIVACY PRESERVING TECHNOLOGIES

The last category of seven papers belongs to security and privacy preserving technologies.

The paper “P2DAP — Sybil Attacks Detection in Vehicular Ad Hoc Networks” by Zhou, Choudhury, Ning, and Chakrabarty presents a lightweight and scalable protocol for VANETs to detect Sybil attacks. The proposed protocol can detect a malicious user, pretending to be multiple (other) vehicles, in a distributed manner through passive overhearing by the so-called road-side boxes (RSBs). Simulation results illustrate that the proposed scheme can achieve good tradeoff between the privacy of vehicles and security, i.e., the detection of Sybil attacks with low overhead and delay.

The next paper “Efficient Certificate Revocation List Organization and Distribution” by Haas, Hu, and Laberteaux proposes a lightweight privacy-preserving mechanism for revoking security certificates appropriate for the limited bandwidth and hardware cost constraints of a VANET. Certificate Authorities use Certificate Revocation Lists (CRLs) to distribute revocation information in an epidemic manner via V2V communications. Simulation results show that the V2V exchange mechanism is quicker than distributing CRLs through RSUs alone.

In the paper “Threshold Anonymous Announcement in VANETs”, Chen, Ng, and Wang present a novel Threshold Anonymous Announcement (TAA) scheme for VANET communications using direct anonymous attestation and one-time anonymous authentication. It is demonstrated that the proposed TAA scheme can satisfy the three security requirements of reliability, auditability, and user privacy preserving against both authorized parties and adversaries.

Hao, Cheng, Zhou, and Song in the paper “A Distributed Key Management Framework with Cooperative Message Authentication in VANETs” present a novel distributed key management scheme based on the short group signature to provide privacy in VANETs. The authors develop security protocols to detect compromised RSUs and their colluding malicious vehicles and propose a practical cooperative message authentication protocol to alleviate the verification burden. A MAC layer analytical model is further developed and ns2 simulations are carried out to examine the key distribution delay and missed detection ratio of malicious messages.

The paper “ABACS: An Attribute-Based Access Control System for Emergency Services over Vehicular Ad Hoc Networks” by Yeh, Chen, and Huang, analyzes the steps involved in a rescue process after an emergency event is reported, and addresses the security and performance issues involved in initiating the rescue process over VANETs. By adopting fuzzy identity-based encryption and novel cryptographic preliminaries, an attribute-based access control system is proposed which can realize security and reduce the computational delay and transmission overhead.

The paper “RSU-based Distributed Key Management (RDKM) for Secure Vehicular Multicast Communications” by Park, Gwon, Jeong, and Seo, presents an efficient group key management (GKM) scheme, the so-called RDKM, for secure multicast services in V2I communications between RSUs and vehicles. The proposed RDKM scheme reduces the communication overhead through decentralizing the management functions for movement across RSUs and update of Key Encryption Keys (KEKs) into each SU. An optimization algorithm is further proposed for the RDKM scheme that minimizes the GKM overhead defined as the weighted sum of the communication and storage overhead.

Finally, the paper “RescueMe: Location-Based Secure and Dependable VANETs for Disaster Rescue” by Sun, Zhu, Zhang, and Fang proposes RescueMe, a location-based secure and dependable post-disaster rescue network, for the efficient allocation of rescue resources. By solving the challenging problem of exploiting the stored location information for postdisaster rescue, and at the same time preserving location privacy in normal network operations, RescueMe offers a functional, secure, and sound networking solution for disaster rescue.

Acknowledgments

The Guest Editors would like to thank all the authors for their enthusiastic response to submit their papers to this special issue. In particular, we thank all the reviewers for their high-quality and timely expert reviews, without which this special issue cannot come to fruition. Special thanks are due to Martha Steenstrup, JSAC Editor-in-Chief, Laurel Greenidge, JSAC Executive Editor, Gunnar Karlsson, JSAC Board Representative, and other JSAC staff, who have all provided significant support throughout the whole process. It has been a great pleasure to put together this special issue on an area that is timely, stimulating, and holds much promise for practical impact.

Cheng-Xiang Wang, Lead Guest Editor
Joint Research Institute for Signal and Image Processing
School of Engineering and Physical Sciences
Heriot-Watt University
Edinburgh EH14 4AS, UK
cheng-xiang.wang@hw.ac.uk

Athanasios V. Vasilakos, Guest Editor
Dept. of Computer and Telecommunications Engineering
University of Western Macedonia
Kozani, 50100, Greece
vasilako@ath.forthnet.gr

Ross D. Murch, Guest Editor
Department of Electronic and Computer Engineering
Hong Kong University of Science and Technology
Clear Water Bay, Kowloon, Hong Kong
eermurch@ust.hk
Cheng-Xiang Wang (S’01-M’05-SM’08) received the BSc and MEng degrees in Communication and Information Systems from Shandong University, China, in 1997 and 2000, respectively, and the PhD degree in Wireless Communications from Aalborg University, Denmark, in 2004. He has been with Heriot-Watt University, Edinburgh, UK since 2005, first as a Lecturer and then as a Reader in 2009. He is also an Honorary Fellow of the University of Edinburgh, UK; a Chair Professor of Shandong University, a Guest Professor of Huazhong University of Science and Technology, an Adjunct Professor of Guilin University of Electronic Technology, and a Guest Researcher of Xidian University, China. He was a Research Fellow at the University of Agder, Grimstad, Norway, from 2001-2005, a Visiting Researcher at Siemens AG-Mobile Phones, Munich, Germany, in 2004, and a Research Assistant at Technical University of Hamburg-Harburg, Hamburg, Germany, from 2000-2001. His current research interests include wireless channel modelling and simulation, cognitive radio networks, vehicular communication networks, green communications, cooperative MIMO communications, cross-layer design of wireless networks, and beyond 4G wireless communications. He has published 1 book chapter and more than 130 papers in refereed journals and conference proceedings. He is leading several projects funded by the EPSRC, Mobile VCE, and industries, including the RCUK funded UK-China Science Bridges: R&D on (B)4G Wireless Mobile Communications.

Dr Wang is currently serving as an Editor for Wireless Communications and Mobile Computing Journal (John Wiley & Sons), Security and Communication Networks Journal (John Wiley & Sons), and Journal of Computer Systems, Networks, and Communications (Hindawi). He also served as an Editor for IEEE Transactions on Wireless Communications from 2007 to 2009. He is the leading Guest Editor for IEEE Journal on Selected Areas in Communications, Special Issue on Vehicular Communications and Networks. He served or is serving as a TPC member, TPC Chair, and General Chair for about 60 international conferences. He received the IEEE GlobeCom’10 Best Paper Award in 2010. Dr Wang is listed in “Dictionary of International Biography 2008 and 2009”, “Who’s Who in the World 2008 and 2009”, “Great Minds of the 21st Century 2009”, and “2009 Man of the Year”. He is a Senior Member of the IEEE, a member of the IET, a Fellow of the HEA, and a member of the EPSRC Peer Review College.

Prof. Vasilakos has served as General Chair, Technical Program Committee Chair, and symposium Chair for many international conferences. He is Chairman of the Intelligent Systems Applications Technical Committee (ISATC) of the IEEE Computational Intelligence Society (CIS). He served or is serving as an Editor or/and Guest Editor for many technical journals, such as the IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS-PART B: CYBERNETICS, the IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, the IEEE Communications Magazine, and the ACM Transactions on Autonomous and Adaptive Systems. He is founding Editor-in-Chief of the International Journal of Adaptive and Autonomous Communications Systems (IJAACS, http://www.inderscience.com/ijaacs) and the International Journal of Arts and Technology (IJART, http://www.inderscience.com/ijsart).

Ross D. Murch (S’85-M’87-SM’98-F’09) is a Chair Professor and Department Head of Electronic and Computer Engineering at the Hong Kong University of Science and Technology. His current research interests include Wireless Communication Systems with a focus on Multiple Input Multiple output (MIMO) Wireless Systems, Compact MIMO Antenna design and Cognitive Radio. His wireless research contributions include over 200 publications and 20 patents and these have attracted over 4000 citations. Prof. Murch is also an IEEE Fellow. Currently Prof. Murch is the Publication Editor for IEEE Transactions on Wireless Communications and was an Area Editor for IEEE Transactions on Wireless Communications from 2006-2009. He was also the Technical Program Chair for the IEEE Wireless Communications and Networking Conference in 2007, Keynote Chair for IEEE International Conference on Communications in 2010, and also the Advanced Wireless Communications Systems Symposium in IEEE International Communications Conference in 2002. He is also a consultant for industry including Huawei, the Applied Science and Technology Research Institute (ASTRI) and is also the founding and current Director of the Center for Wireless Information Technology at the Hong Kong University of Science and Technology. In July 2005, he was invited to the School of Engineering Science, Simon Fraser University, Canada, as the David Bensted Fellow and in July 2004 he visited Southampton University, UK as an HKTIT fellow. He was also a keynote speaker at IEEE GCC 2007, IEEE WiCOM 2007 and IEEE APWC 2008. Prof. Murch received his PhD in Electrical and Electronic Engineering from the University of Canterbury, New Zealand.
Gordon L. Stüber (S’81-M’82-SM’96-F’99) received the B.A.Sc. and Ph.D. degrees in Electrical Engineering from the University of Waterloo, Ontario, Canada, in 1982 and 1986 respectively. In 1986, he joined the School of Electrical and Computer Engineering, Georgia Institute of Technology, where he holds the Joseph M. Pettit Chair in Communications. Dr. Stüber is author of the textbook Principles of Mobile Communication, Kluwer Academic Publishers, 1996, 2/e 2001. He was co-recipient of the Jack Neubauer Memorial Award in 1997 for the best systems paper published in the IEEE Transactions on Vehicular Technology. He became an IEEE Fellow in 1999 "for contributions to mobile radio and spread spectrum communications." He received the IEEE Vehicular Technology Society James R. Evans Avant Garde Award in 2003 "for his contributions to theoretical research in wireless communications." In 2007, he received the IEEE Communications Society Wireless Communications Technical Committee Recognition Award (2007) “for outstanding technical contributions in the field and for service to the scientific and engineering communities.”

Dr. Stüber served as Technical Program Chair for the 1996 IEEE Vehicular Technology Conference (VTC96), Technical Program Chair for the 1998 IEEE International Conference on Communications (ICC98), General Chair of the Fifth IEEE Workshop on Multimedia, Multiaccess and Teletraffic for Wireless Communications (MMT2000), General Chair of the 2002 IEEE Communication Theory Workshop (CTW02), and General Chair of the Fifth YRP International Symposium on Wireless Personal Multimedia Communications (WPMMC2002). He is a Past Editor for Spread Spectrum with the IEEE Transactions on Communications (1993-1998), and a past member of the IEEE Communications Society Awards Committee (1999-2002). He served as an elected Member-at-Large on the IEEE Communications Society Board of Governors (2007-2009), and is currently an elected member of the IEEE Vehicular Technology Society Board of Governors (2001-2003, 2004-2006, 2007-2009, 2010-2012). He received the IEEE Vehicular Technology Society Outstanding Service Award in 2005.

Xuemlin (Sherman) Shen (M’97-SM’02-F’09) received the B.Sc. degree from Dalian Maritime University, Dalian, China, in 1982 and the M.Sc. and Ph.D. degrees from Rutgers University, Camden, NJ, in 1987 and 1990, respectively, all in electrical engineering.

He is currently a Professor and the University Research Chair with the Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, ON, Canada. Dr. Shens research focuses on resource management in interconnected wireless/wired networks, UWB wireless communications networks, wireless network security, wireless body area networks and vehicular ad hoc and sensor networks. He is a co-author of three books, and has published more than 400 papers and book chapters in wireless communications and networks, control and filtering.

Dr. Shen served as the Technical Program Committee Chair for IEEE VTC2010, the Symposium Chair for IEEE ICC2010, the Tutorial Chair for IEEE ICC08, the Technical Program Committee Chair for IEEE Globecom07, the General Co-Chair for Chinacom07 and QShine06, the Founding Chair for IEEE Communications Society Technical Committee on P2P Communications and Networking. He also served as a Founding Area Editor for IEEE Transactions on Wireless Communications (2004), Editor-in-Chief for Peer-to-Peer Networking and Application; Associate Editor for IEEE Transactions on Vehicular Technology; Computer Networks; and ACM/Wireless Networks, etc., and the Guest Editor for IEEE JSAC, IEEE Wireless Communications, IEEE Communications Magazine, and ACM Mobile Networks and Applications, etc. Dr. Shen received the Excellent Graduate Supervision Award in 2006, and the Outstanding Performance Award in 2004 and 2008 from the University of Waterloo, the Premiers Research Excellence Award (PREA) in 2003 from the Province of Ontario, Canada, and the Distinguished Performance Award in 2002 and 2007 from the Faculty of Engineering, University of Waterloo. Dr. Shen is a registered Professional Engineer of Ontario, Canada, an IEEE Fellow, and a Distinguished Lecturer of IEEE Communications Society.

Wai Chen received his B.S.E.E. degree from Zhejiang University; M.S.E.E., M.Phil., and Ph.D. degrees from Columbia University in the City of New York. Currently, he is a Director and Chief Scientist at Applied Research, Telcordia Technologies Inc. (formerly known as Bellcore). Dr. Chen has been leading a vehicular communications research program in collaboration with a major automaker, since 2000, on automotive networking technologies for vehicle safety and information applications. He was Principal Investigator of several government funded projects on advanced networking technologies research.

Dr. Chen is the Series Editor for Automotive Networking - Technology, Design, and Applications of the IEEE Communications Magazine (since 2008), and the General Co-Chair for the IEEE Vehicular Networking Conference (IEEE VNC 2010, IEEE VNC 2009). He has also served as a Guest Editor for Special Issue on Inter Vehicular Communication (IVC) for the IEEE Wireless Communications Magazine (2006), the IEEE Distinguished Lecturer (2004-2006), the Co-Chair for Vehicle-to-Vehicle Communications Workshop (IEEE V2VCOM 2005-2008) co-located at IEEE Intelligent Vehicles Symposium, the Co-Chair for the IEEE Workshop on Automotive Networking and Applications (IEEE AutoNet 2006-2008) co-located with IEEE Globecom, and the Vice Chair of Technical Program Committee for Vehicular Communications of the IEEE Vehicular Technology Conference (IEEE VTC Spring 2009).

Timo Kosch studied computer science and economics at the Darmstadt University of Technology and the University of British Columbia at Vancouver. He received his PhD in computer science from the Munich University of Technology.

Dr. Kosch is currently a team manager at BMW Group Research and Technology. He is responsible for projects on distributed systems, including research topics like cooperative systems for traffic efficiency and active safety, connected vehicle infrastructures and automotive security. He contributed to a number of national and international research programs, e.g. as coordinator for the European project COMeSafety, head of system development for the German Car2X field trial and chair of the architecture working group for the Car-to-Car Communication Consortium for which he is now serving as a Steering Committee member. He has published more than twenty scientific and technical articles on vehicle communications and has supported more than a dozen scientific workshops and conferences in different roles, as panelist, keynote speaker, technical program committee member and chair. He is also a series editor of the Automotive Networking Series of the IEEE Communications Magazine.