Foreword

Raúl Aquino Santos, Arthur Edwards, and Victor Rangel have edited this new book to reflect the present and future challenges in wireless technologies for vehicular ad hoc networks. New technologies are being developed for vehicular ad hoc networks, and these networks provide an efficient method for today’s complex vehicle communications. Emerging vehicular ad hoc networks in the forms of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications are a cornerstone of the envisioned Intelligent Transportation Systems (ITS).

By enabling vehicles to communicate with other vehicles via V2V communication as well as with roadside infrastructure via V2I communication, vehicular ad hoc networks will enable a variety of applications for safety, traffic efficiency, driver assistance, and infotainment. For the safety requirements, vehicular network technologies will be applied to reduce accidents so as to save lives and reduce injuries. Examples of such applications include vehicle breakdown and obstacle detection, lane departure warnings, accident warnings, collision warnings, over-height/over-width warnings, turnover warnings, work zone warnings, black box recorder to register accident forensics, and so on. For traffic efficiency, vehicular network technologies will be applied to improve the flow of traffic and reduce congestion, for example, cooperative adaptive cruise control, highway/rail intersection traffic management, congestion information for traffic control, electronic toll collection, et cetera. For driver assistance, vehicular networks can also provide accurate information and data, as well as good communications for drivers to improve safety and security, e.g., advanced navigation systems, parking information, real-time traffic information, various kinds of warning information, driver’s daily blog, automatic emergency calls, and so on.

This book has provided wireless technologies from the physical layer to the application layer and new research challenges for vehicular ad hoc networks to realize the above exciting applications. First, this book describes the physical layer characteristics for the wireless channel, and identifies the distinguishing features of V2V channels. Due to the low antenna elevations, and mobility of both transmitters and receivers in the V2V environment, the V2V wireless channel can be one of the most challenging elements to ensuring reliable V2V communication. Hence, channel modeling and modulation and coding techniques for V2V communications are presented in this book. It then introduces a detailed description of the major features and operating principles provided by Physical (PHY) and Medium Access Control (MAC) layers of the IEEE 802.11p and IEEE 1609 standard suites to support Wireless Access in Vehicular Environments (WAVE). It further presents the alternative MAC solutions based on a synchronous, slotted philosophy. It also describes the channel impairments for V2V communications in ITS scenarios so as to identify areas for the new performance evaluation model design.

Second, this book presents technologies related to ad hoc routing and medium access control strategies for vehicular ad hoc networks. Due to high mobility, it is very challenging to establish and maintain a
communication link in vehicular networks. Therefore, this book introduces WiMAX as medium access technology and geographic strategies for routing algorithms. Furthermore, it presents an evaluation of the LORA-CBF geographic routing algorithm that permits seamless communication in an ad-hoc WiMAX network.

Third, this book presents development challenges and opportunities of applications in Intelligent Transport System. It gives readers a global vision of the issues related to the development of applications for vehicular ad-hoc networks, and presents a classification and an overview of top-level application domains. It then presents the communication architectures on which Intelligent Transport Systems rely. It also addresses the challenges and issues with cooperative positioning, data dissemination, and heterogeneous communications for vehicular ad hoc networks.

Last but not least, security issues in deploying vehicular ad hoc networks are addressed, and the most outstanding security approaches are discussed. As a proof of concept, it presents a PKI-based protocol, able to cope with the interoperability issues among un-trusted CA (certificate authority) domains, and the trade-offs between security and performance are empirically analyzed.

I have known Dr. Santos since 2007 when I edited a book on Automotive Informatics and Communicative Systems: Principles in Vehicular Networks and Data Exchange. At that time, he contributed an interesting chapter of Inter-vehicular Communications using Wireless Ad Hoc Networks. From 2007 until now, he has shown the great passion and devoted his time and effort to this area. Thus, I highly recommend Dr. Santos’s timely book. I believe it will benefit many readers and inspire them to conquer the challenges mentioned in this book for vehicular ad hoc networks.

Huaqun Guo
Institute for Infocomm Research, A*STAR, Singapore

Huaqun Guo obtained B.Eng and M.Eng from Tianjin University in 1989 and 1991, respectively, and obtained M.Eng and PhD from the National University of Singapore (NUS) in 2001 and 2007, respectively. She was a Senior Engineer, Kent Ridge Digital Labs (KRDL), Singapore from 2000 to May 2001. She was a senior research staff, NUS from June 2001 to March 2003. She is IEEE Member from 2007, and IEEE Senior Member from 2009. Currently she is Scientist at the Institute for Infocomm Research (I2R), Agency for Science Technology and Research (A*STAR) in Singapore. She has published more than 40 papers in the international journals, conferences, and books. She is an editor of a book, Automotive Informatics and Communicative Systems: Principals in Vehicular Networks and Data Exchange. She is member of an Editorial Board, and TPC member and session chair for 16 international journals and conferences. Her research areas include multicast, vehicular network, security, P2P computing, networked middleware, and multimedia communication system.