



The Internet of vehicles and smart cities

Lyes Khoukhi¹ · Hu Xiong² · Saru Kumari^{3,4} · Nicolas Puech⁵

Published online: 7 October 2021

© Institut Mines-Télécom and Springer Nature Switzerland AG 2021

1 Introduction

Smart city integrates innovative technologies and solutions to manage the assets of cities including transportation, electricity supply, and other pivotal infrastructure. Internet of vehicle (IoV) is the latest technology designed for smart city in transportation. Through wireless communication and sensing technology, IoV creates a network of information interaction among vehicles, roadside infrastructure, and surrounding environments. Diverse kinds of data gathered from vehicular devices reflect the current traffic conditions of smart city (e.g., traffic accidents, traffic jams, and public transport delays) in real time.

By using the data appropriately, IoV not only provides drivers with the best driving routes, but also enables emergency prevention and rapid response, so that the traffic safety and onboard experience can be improved significantly, which is regarded as the main contribution of IoV for smart city. Despite these advantages, the sustainability of IoV is subject to numerous potential risks in safety and performance, such as control malfunction and low energy efficiency. Besides, the connectivity for IoV has become a growing concern due to the complexity of the transportation system. The research on IoV requires the expertise of various fields, from information communication technology to energy and civil engineering.

This special issue aims to fill this gap and brings the recent research outcome to advance knowledge of problems

and solutions applicable to IoV in smart city. A wide range of topics are covered such as security, trust and reputation of IoV, performance of IoV, data dissemination and clustering systems, and new trends of IoV in smart city.

2 Reviewing process and selected papers

We received several submissions of high interest evaluated by at least three experts. A thorough reviewing process ensuring the quality of both content and form, and guaranteeing the scientific and technical accuracy led to the acceptance of 15 articles. Hereafter, we provide a summary of each paper accepted in this special issue.

In the paper entitled “Challenges and Limits of Fractal and Slot Antennas for WLAN, LTE, ISM and 5G Communication: A Review Paper”, Amer Tawfeeq Abed and his colleagues review several related studies on the design of antennas for all frequency bands required for Wi-Fi, LTE and WiMAX applications. They provide suggestions as a guideline for antenna designs and future work in designing antennas for Wi-Fi, LTE and WiMAX communications according to the market needs and ways of overcoming the current limits.

Shaobo Huang and his colleagues propose a “Joint Mobile Vehicle–UAV Scheme for Secure Data Collection in a Smart City”, for cheap and secure data collection. In this scheme, an UAV is adopted to collect baseline data from sensors to evaluate the trust of mobile vehicles, and a high-trust priority recruitment strategy is proposed to recruit credible mobile vehicles at a low cost.

The paper by Mengying Ren and her colleagues entitled “A Review of Clustering Algorithms in VANETs” explores the vehicle clustering techniques from the aspects of cluster head selection, cluster formation, and cluster maintenance procedures. Moreover, context-based clustering algorithms are summarized, and the hybrid clustering algorithms are highlighted. The paper also presents existing clustering performance metrics and performance evaluation approaches.

✉ Lyes Khoukhi
lyes.khoukhi@ensicaen.fr

¹ University of Technology of Troyes, Troyes, France

² University of Electronic Science and Technology of China, Chengdu, China

³ Department of Mathematics, Ch. Charan Singh University, Meerut, India

⁴ National Institute of Technology Karnataka, Mangalore, India

⁵ Institut Mines Telecom, Paris, France

In the paper entitled “Secure Outsourced Attribute-Based Signcryption for Cloud-Based Internet of Vehicles in a Smart City” by Negalign Wake Hundera and his colleagues, an attribute-based signcryption scheme is presented to provide confidentiality, authenticity, and sender secrecy of the data stored in the cloud. In addition, this work reduces the computational load at the IoV node and the authorized user’s side by outsourcing the signcryption and unsigncryption algorithms.

Fadlallah Chbib and his colleagues introduce “IEEE 802.11p Performance Enhancement based on Markov Chain and Neural Networks for Safety Applications” to ensure the delivery of urgent safety messages to the receiver whatever the situation of the network. The idea is to control the rate of periodic messages in control channels, by modifying the back-off parameters according to the state of the buffer.

In the paper entitled “3DMAT: Data Dissemination for Disaster Management using Available Technology in a Smart City,” Amira Ichrak and her colleagues present an opportunistic data dissemination protocol for disaster management in which both sensors and vehicular networks participate in decision making for the dissemination process so that messages are delivered in a timely manner.

In the article entitled “Infrastructure Localization Service and Tracking Scheme in Uncovered Areas for Internet of Vehicles”, Chahrazed Ksouri and her colleagues design a scheme to supply vehicles with contextual information about the infrastructure accessibility and the neighborhood, in order to track available paths and to forward promptly safety and non-safety-related information.

In the paper entitled “Network Slicing for Vehicular Communications: A Multi-Agent Deep Reinforcement Learning Approach”, Zoubair Mlika and his colleagues study the multi-agent resource allocation problem in vehicular networks using non-orthogonal multiple access and network slicing. They provide a mathematical programming formulation and a thorough NP-hardness analysis of the problem. Then, they model it as a multi-agent Markov decision process and provide a solution using a deep reinforcement learning approach.

Hayet Zerrouki and her colleagues propose a “Reinforcement Learning-based Clustering Scheme for the Internet of Vehicles” to assure dynamic and cooperative maintenance for clusters. This scheme enables the maximization of the network lifetime and the minimization of the communication overhead. In addition, it avoids unnecessary re-clustering, and hence maintains more stable cluster formations than those obtained with other approaches.

In the paper entitled “A Novel Collision Avoidance Scheme for Smart Parking”, Soumaya Dahi and her colleagues propose an approach that aims to help drivers shorten their search time inside parking lots, reduce costs by consuming less fuel and also feel less stressed during this daily routine task. The obtained results show the effectiveness of this approach in

resolving the contention and reducing the collision among vehicles by about 88%.

Abdelah Kaci and his colleagues present a “Named Data Networking Architecture for Internet of Vehicles in the Era of 5G” to predict the number of content requests, so that popular contents are kept as long as possible on roadside units. The proposed scheme is also used to predict the storage capacity required by each roadside unit.

In the paper entitled “Testbed of V2X Infrastructure for Autonomous Vehicles”, Naila Bouchemal and Sondes Kallel describe a testbed V2X infrastructure with components to test the real effectiveness of V2X systems for autonomous driving using dedicated short range communications technology. They show the testbed integration within the autonomous vehicle on the one hand and within the infrastructure module on the other hand.

Lamia Chaari Fourati and her colleagues propose an “ICN Clustering Based Approach for VANETs” to guarantee network continuity without impacting its mobility when the ICN paradigm is used. They show, through scenarios in real-world contexts, that ICN allows vehicles to enhance their content delivery ratio, the average delay for content delivery and the transmission overhead.

In the article entitled “Enhancing Video Dissemination over Urban VANETs Using Line of Sight and QoE Awareness Mechanisms”, Lazhar Khameir and his colleagues propose a receiver-based, line-of-sight-aware and reliable bi-directional broadcasting protocol that obtains a tradeoff between broadcast reliability and coverage capabilities. The protocol overcomes packet loss by including an enhanced version of the store-carry-and-forward method that prioritizes the retransmission of packets containing more important video blocks.

In the paper entitled “Junction-based Stable Clustering Algorithm for Vehicular Ad hoc Network”, Mohammad Mukhtaruzzaman and Mohammed Atiquzzaman propose a dynamic mobility-based clustering algorithm junction-based clustering for VANET. The authors consider several parameters in their design and show that the presented algorithm achieves higher stability, while preventing frequent breaking of the clusters at the junction.

Acknowledgements First, we would like to thank all the authors and reviewers for the quality of their contribution that made this special issue possible. We hope that this selection of papers will provide the readers with an overview of the main trends and current research issues in the area of Internet of vehicles and smart cities.

The Guest Editors would like to express their deep appreciation to the Editor-in-Chief, Prof. Guy Pujolle, for giving the opportunity to publish this special issue. We also thank the Deputy Editor-in-Chief, Nicolas Puech, and the Managing Editor, Laurence Monéger, as well as the journal editorial staff for their continuous support during the publishing process.

Publisher’s note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.