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Guest Editorial Special Issue on Toward Securing Internet of Connected Vehicles (IoV) From Virtual Vehicle Hijacking

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Guest Editorial
Special Issue on Toward Securing Internet of Connected Vehicles (IoV) From Virtual Vehicle Hijacking

TODAY'S vehicles are no longer stand-alone transportation means, due to the advancements on vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications enabled to access the Internet via recent technologies in mobile communications, including WiFi, Bluetooth, 4G, and even 5G networks. The Internet of vehicles was aimed toward sustainable developments in transportation by enhancing safety and efficiency. The sensor-enabled intelligent automation of vehicles' mechanical operations enhances safety in on-road traveling, and cooperative traffic information sharing in vehicular networks improves traveling efficiency.

However, safety and efficiency oriented sustainability in transportation via Internet of Connected Vehicles (IoV) comes with greater risk of virtual vehicle hijacking, with examples ranging from unauthorized accessing of wheels, disabling brakes, locking doors, and engine disruption to path forging, location and identity manipulation, denial of traffic service, and tracking. We have witnessed security threats in computer networks in terms of unauthorized system and application hijacking on a greater scale targeting particular individuals, specific organizations, or even entire systems of a country. So there is also a necessity to prepare for a virtual vehicle hijacking in IoV, concerning the reliable, ubiquitous, and seamless IoV communication.

The literature on V2V and V2I-centric connected vehicles has vastly contributed toward efficient communication and analysis of accumulated traffic information leading toward optimization of fuel and time in traveling, and enabling on-time smart mechanical decisions on roads, respectively. The need for communication-centric study on IoV is due to the challenges in technical migration of protocols, techniques, and standards from static wireless communication to highly mobile vehicular communication environments. However, in the current IoV scenario, where virtual hijacking of connected vehicles is possible, the modeling and practice for securing connected vehicles has not gained enough attention from academia and industries focusing on smart technologies for greener transportation.

The aim of this special issue is to fill this gap, and create a forum for researchers and developers from academia and industries to publish their recent outcomes. The response to our Call for Papers on this special issue was satisfactory, with 20 submissions from around the globe. During the review process, each paper was assigned to and reviewed by at least three experts in the relevant areas, and with a rigorous two-round review process, we were able to accept seven excellent articles covering the scope of this special issue.

The paper "Novel Beamforming Approach for Secure Communication in UDN to Maximize Secrecy Rate and Fairness Security Assessment" by Chopra *et al.* examines the security challenges of high-speed users for ultradense network (UDN) under dense picocells deployment. By considering a dense condition where users are randomly distributed within the picocell for vehicular users, the paper proposes beam broadening (BB) and beam merging (BM) techniques that ensure reliable transmission between source and destination, and proves the effectiveness of the proposed approach through mathematical and simulation analysis that guarantees high QoS and secure communication.

The paper "Dynamic Scalable Elliptic Curve Cryptographic Scheme and Its Application to In-Vehicle Security" by Wang *et al.* suggests a dynamic scalable elliptic curve cryptosystem. To synchronize the curve in use, a curve list of different security levels is generated and preserved on both parties. Since both parties randomly choose the curve and the prime number, an extra security level is provided, so that the security level can still remain the same even using smaller key sizes, while the computation efficiency will be enhanced and the power consumption will be reduced, which is especially suitable for application in on-board embedded devices.

The paper "On Location Privacy-Preserving Online Double Auction for Electric Vehicles in Microgrids" by Li *et al.* addresses the issue of demand response in microgrids via V2V technology in the smart grid with consideration for location privacy protection supported by Internet of Vehicles (IoV). The paper presents a new truthful online double auction scheme, which features multiunit energy trading among electric vehicles (EVs), routing optimization for EV charging, and location privacy protection. A theoretical analysis demonstrates that the online double auction scheme is capable of achieving several important economic properties as well as the privacy guarantee (i.e., *k*-anonymity).

The paper "TrustVote: Privacy-Preserving Node Ranking in Vehicular Networks" by Azad *et al.* presents TrustVote, a collaborative crowdsourcing-based vehicle reputation system that

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enables vehicles to evaluate the credibility of other vehicles in a connected vehicular network. The TrustVote system allows participating vehicles to hide their rating/feedback scores and the list of interacted vehicles under a homomorphic cryptographic layer, which can only be unfolded as an aggregate. The proposed approach also considers the trust weight of a vehicle providing the rating scores while computing the aggregate reputation of the vehicles. A prototype of TrustVote is developed and its performance is evaluated in terms of the computational and communication overheads.

The paper "Security in Vehicles With IoT by Prioritization Rules, Vehicle Certificates, and Trust Management" by García-Magariño *et al.* develops a novel agent-based simulator about security in IoT for V2V communications (ABS-SecIoTV2V). The experiments focus on the scenario of avoidance of collisions with hijacked vehicles misinforming other vehicles. The simulation results show that in the current approach, vehicles properly distinguished hijacked vehicles from others, by managing trust and reputation based on the information directly observed and that received from other vehicles. The simulation results also show that the current approach improved traffic flow performance as reflected in the increase of average speed of vehicles.

The paper "TACASHI: Trust-Aware Communication Architecture for Social Internet of Vehicles" by Kerrache *et al.* proposes a trust-aware communication architecture for social IoV (TACASHI) to connect SIoVs and online social networks (OSNs) for the purpose of estimating the honesty of the drivers and passengers based on their OSN profiles. The authors compare the current location of the vehicles with their estimated path based on their historical mobility profile, then combine SIoV, path-based and OSN-based trusts to compute the overall trust for different vehicles and their current users. TACASHI offers a trust-aware social in-vehicle and intervehicle communication architecture for SIoVs considering also the drivers, honesty factor based on OSN.

The paper "Cybersecurity Measures for Geocasting in Vehicular Cyber Physical System Environments" by Kumar *et al.* presents cybersecurity measures for geocasting in vehicular traffic environments (CMGV) focusing on security-oriented vehicular connectivity. Specifically, a vehicular intrusion prevention technique is developed to measure the connectivity between the cache agent and cache user vehicles. The connectivity between static transport vehicles and cache agent/cache user is measured via vehicular intrusion detection approach. The performance of the proposed vehicular cybersecurity measure is evaluated in realistic traffic environments.

To conclude, the Guest Editors would like to thank all the authors for their contributions to this special issue, and all the reviewers for their excellent reviews. We also would like to give special thanks to Dr. Sherman Shen, the Editor-in-Chief of the IEEE INTERNET OF THINGS JOURNAL, and all the Journal's staff for their help in the publication process. We hope you will enjoy this special issue!

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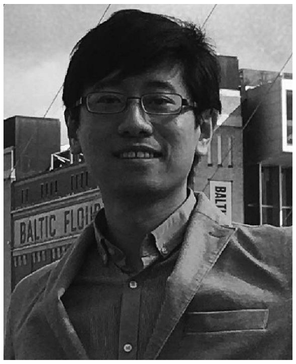

Yue Cao received the Ph.D. degree from the Institute for Communication Systems (ICS) (formerly, Centre for Communication Systems Research), University of Surrey, Guildford, U.K., in 2013.

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Dr. Ahmad served as a Reviewer for a number of journals, including *IEEE Communication Magazine*, IEEE COMMUNICATIONS LETTERS, and the IEEE TRANSACTIONS ON DEPENDABLE AND SECURE COMPUTING.