As a special cloud computing platform, connected vehicular cloud computing (CVCC), which seamlessly combines cloud computing and VANETs, has been recently proposed to accelerate the adoption of VANETs, and extends the traditional cloud infrastructure consisting of a majority of stationary nodes to the edge of vehicles. CVCC is a mobile computing paradigm that consists of in-motion vehicles cooperating with each other to achieve a bunch of practical applications, such as collaborative package delivery and information dissemination. Essentially, CVCC coordinates the computing, communication, sensing, and storage resources of vehicles on the road to balance the service requirements and hardware limitations. Because of these advantages, CVCC has been regarded as a key basis of future competition and innovation, and has attracted considerable attention from both industry and academia in recent years.

Nevertheless, different from the traditional cloud infrastructure, CVCC requires sophisticated security and privacy protection mechanisms as legitimate users and attackers have the same privileges in CVCC. Thus, attackers can utilize system loopholes to reach their goals, such as obtaining confidential information and tampering with the integrity of information and the availability of resources. Therefore, in order to enhance the security and scalability of CVCC, a set of security and privacy requirements such as authentication, nonrepudiation, anonymity, and traceability should be met in accordance with the expected characteristics of CVCC, and a number of crucial issues such as trust model, data security, connection fault, and query tracking attacks must be addressed. Although traditional security mechanisms are plentiful today, they are inadequate to solve the emerging security challenges in CVCC, as they are tailored to securing the conventional cloud paradigm or vehicular ad hoc networks (VANETs).

The response to our Call for Papers for this Special Issue was overwhelming, with 34 papers submitted from around the world. During the review process, each paper was assigned to and reviewed by multiple experts in the relevant areas, with a rigorous two-round review process. Thanks to the courtesy of the Editor-in-Chief of IEEE Network, Prof. Nei Kato, we were able to accept 12 excellent articles covering various aspects of security and privacy challenges of CVCC. In the following, let us introduce these articles and highlight their main contributions.

In “Fog-Aided Verifiable Privacy Preserving Access Control for Latency-Sensitive Data Sharing in Vehicular Cloud Computing,” the authors propose a novel fog-to-cloud base architecture for data sharing in VCC. The scheme is a cryptography-based mechanism that conducts fine-grained access control. In their design, the complicated computation burden is securely outsourced to fog and cloud servers with confidentiality and privacy preservation. Meanwhile, with prediction of vehicles’ mobility, pre-pushing data to specific fog servers can further reduce the response latency with no need to consume more resources of fog servers. In addition, with the assumption of no collusion between different providers of the cloud and fog servers, the proposed scheme can provide verifiable auditing of fog servers’ reports. The scheme is provably secure against the existing adversaries and newborn security threats. Experiments show significant performance improvement in edge devices’ cost overhead and response time.

Channel capacity, as the key parameter to measure channel utilization, plays an important role in ensuring the reliability of CVCC service and the integrity of transmission data. In past decades, the existing calculation methods could not solve the channel capacity problem in multi-participant VANETs. Different from the traditional calculation methods, in “A Secure and Efficient Transmission Method in Connected Vehicular Cloud Computing,” the authors propose a novel calculation method by combining the core concepts of game theory and information theory. The proposed method can calculate the channel capacities of multiple vehicular networks efficiently, and has many potential applications in different services of CVCC.

CVCC can be applied in various scenarios, particularly in vehicular crowdsensing, as it can make full use of sensing, computing, and storage resources of the vehicles. However, malicious vehicles may impede its proliferation by providing untruthful data to affect the accuracy of sensing results. In “RTSense: Providing Reliable Trust-Based Crowdsensing Services in CVCC,” the authors study how to provide reliable trust-based crowdsensing services in CVCC, called RTSense. First, they present the architecture of RTSense. After that, they focus on how to capture security and privacy in RTSense, and propose possible solutions including anonymous vehicle authentication, and interactive filtering truth discovery and trust management to achieve security assur-
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In “Integrated Authentication and Key Agreement Framework for Vehicular Cloud Computing,” the authors try to identify the security goals for the interoperability with VCC and provide an authentication and key agreement (AKA) framework for VCC. Specifically, the authors first present the research challenges and open problems for designing a reliable AKA with strong security guarantees for VCC. Then the authors propose an integrated AKA framework that integrates single-server 3-factor AKA protocol and non-interactive identity-based key establishment protocol. Finally, the authors prove the utility of the proposed scheme by conducting experiments on a simulated experimental platform.

In “Secure Outsourcing Computing in Connected Vehicular Cloud Computing,” the authors aim to exploit new challenges of outsourcing computing in CVCC. Since pairing-based cryptographic primitives are of particular interest among the cryptographic tools used in CVCC, they devote their attention toward the security challenges and efficiency requirements of outsourcing pairing from vehicles to vehicles in CVCC. Furthermore, they give a pairing outsourcing protocol for illustration, which indicates that secure and effective pairing outsourcing in CVCC is possible. Furthermore, they also identify some future research directions in secure CVCC.

In “Collaborative Security in Vehicular Cloud Computing: A Game Theoretic View,” the authors first present a CVCC architecture and its applications. Then they study several security issues in vehicular cloud computing. Afterward, they model a CVCC network by a two-phase heterogeneous public good game (HPGG), and then investigate the influence of different incentive mechanisms and the structure of the vehicles’ investment rate. Finally, the authors come to a conclusion.

Electric vehicles cloud and edge (EVCE) computing is an attractive network paradigm involving seamless connections among heterogeneous vehicular contexts. It will be a trend along with electric vehicles (EVs) becoming popular in vehicle-to-everything (V2X). The EVs act as potential resource infrastructures referring to both information and energy interactions, and there are serious security challenges for such hybrid cloud and edge computing. In “Blockchain-Enabled Security in Electric Vehicles Cloud and Edge Computing,” the authors discuss the rationale and the concrete methods presented in the literature. In particular, they illustrate how to launch successful attacks through a controlled area network bus, electronic control units, and an in-vehicle infotainment system. The article also suggests some feasible solutions to the attacks demonstrated by the community. Considering the fact that vehicles are safety-critical, more practical and effective steps should be taken within the connected vehicle network toward securing the connected vehicles and protecting drivers and passengers.

High-speed rail (HSR), an increasingly efficient means of transportation, faces several challenges in terms of high-frequency handover at speeds over 300 km/h. This includes large volumes of data of different types and different degrees of importance. In “SVCC-HSR: Providing Secure Vehicular Cloud Computing for Intelligent High-Speed Rail,” the authors propose a novel and practical secure vehicular cloud computing system for HSR (SVCC-HSR), based on the long-term research and practice in this field. SVCC-HSR not only considers the various technical features of vehicular cloud computing, but also addresses several special demands in the HSR context. The authors perform extensive experiments using various scenarios, including frequent handover scenarios in high-speed trains running at 300 km/h with large-volume data transmission scenarios in locomotive depots. The real-world experimental results demonstrate that SVCC-HSR achieves better performance on fast authentication, hierarchical attribute-based data encryption, and transmission.

In “Collaborative Security in Vehicular Cloud Computing: A Game Theoretic View,” the authors first present a CVCC architecture and its applications. Then they study several security issues in vehicular cloud computing. Afterward, they model a CVCC network by a two-phase heterogeneous public good game (HPGG), and then investigate the influence of different incentive mechanisms and the structure of the vehicles’ investment rate. Finally, the authors come to a conclusion.
then discuss three promising technologies, non-orthogonal multiple access, multi-access-assisted computation offloading, and mobility- and delay-aware offloading, which facilitate the enhancement of secrecy against the eavesdropping attack. Finally, as a detailed example of multi-access-assisted computation offloading, the authors present a case study on the optimal dual-connectivity-assisted computation task offloading with secrecy provisioning and show the performance of the proposed computation offloading. Finally, we would like to express our thanks to all the authors for their support and excellent contributions. We also would like to thank all the reviewers for their volunteered efforts in reviewing the papers, and for their insightful comments and constructive suggestions for improving the quality of the articles. Respectfully, we appreciate the advice and support of the Editor-in-Chief of *IEEE Network*, Prof. Nei Kato, for his help in the whole publication process.

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