Guest Editorial Special Issue on Green Communication and Networking for Connected and Autonomous Vehicles

WITH the advancements in Internet of Things (IoT) and communication technologies (5G beyond/6G), Connected and Autonomous Vehicles (CAV) is eventually being realized and will make a major contribution to the development of smart mobility systems in the pursuit of green and sustainable economies. Cooperative driving features allowed by CAVs will dramatically reduce CO_2 emissions, allowing for more environmentally friendly intelligent, smart and sustainable transportation. More sophisticated green communication and networking computation technologies are needed for CAVs environments due to the heterogeneity of networking organizations, strict implementation specifications, and restricted resources.

Future CAVs networks would have a greater range of sensors and multi-access edge settings, allowing for more effective use of various modes of frequency spectrum. Simultaneously, novel services reduced travel time, cooperative autonomous driving, reduced maintenance and infrastructure costs, improved energy efficiency, etc. all require unparalleled high precision and reliability, ultra-low latency, and wide bandwidth. Even though Green communication for CAVs is a potential disruptive research direction that can revolutionize the typical transportation system, it is not being fully realized as several challenges in CAVs are yet to be addressed. Some of the critical challenges in the realization of CAVs are data storage, privacy and security issues, energy optimization of the IoT sensors in the vehicles, regulatory uncertainties, real time analytics of the big data generated from CAVs, etc.

The aim of this special issue is to motivate innovative research on Connected and Autonomous Vehicles for achieving green communication, computing, and sensing in future intelligent transportation system. The issue attracted over 100 high-quality submissions from all over the world, among which 29 original contributions were eventually selected for publication. The novelty and key contributions of these articles are summarized as follows.

The study by Li *et al.* [A1] proposed a framework for analysis of Location Privacy-Preserving Mechanisms for navigation services of connected and autonomous vehicles. The proposed solution addresses the issue of preserving privacy while sharing the location data with untrustworthy navigation service providers. Some extra information of adversaries performing the localization attacks are captured by the proposed framework. The authors have also proposed two new metrics to quantify privacy of the location in navigation services, namely visibility and accuracy.

Green vehicular networks focus on reducing the impact of vehicular emissions on the environment. State of the art has shown that the infrastructure costs can be reduced and network efficiency can be improved by grouping the vehicles into clusters in green vehicular networks. However, reducing the communication costs and maintaining the network connectivity are critical challenges of green vehicular networks. To address these issues, the study by Liu *et al.* [A2] firstly designed a state resemblance prediction model that is based on trajectory feature relevance among the vehicles. Along with resemblance prediction model, the authors have proposed a region based collaborative management scheme for realizing dynamic clustering of vehicles.

In recent years there is an increased demand for green unmanned aerial vehicles in military as well as civilian applications. However, efficient usage of the resources in resource critical unmanned aerial vehicles is vital for improving quality of service and maximizing network lifetime. To improve the channel utilization and optimize the through put of the unmanned aerial vehicles in a communication network, the study by Abul Hassan *et al.* [A3] proposed Fisheye State Routing protocol.

The study by Rahim *et al.* [A4] proposed a risk management framework named VEHMS, including an efficient decision model, to monitor vehicular engine health and diagnose its condition in real-timely, exploiting vulnerable components with the help of machine learning algorithms. Further, they developed a decision model employing I-VAM with vehicular structural information using the sensor-actuator besides some influencing parameters to categorize the diagnosed vehicular engine condition as good, minor, moderate, and critical. They evaluated the performance of the proposed framework using Machine Learning (ML) and Deep Learning (DL) algorithms in the term of decision accuracy.

The study by Kumar *et al.* [A5] designed an intelligent system based on Yolo 3 neural network architecture to visualize the traffic signs and recognize the obstacles on the road by using the images from the camera from moving vehicles. In this work, the authors proposed a 5G enabled vehicular network, in which vehicles will be sharing the information

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regarding obstacles and road condition with other vehicles in the network. The machine learning algorithms are used in this work for training the real-time images acquired from the vehicles to prevent accidents and reduce the pollution.

The study by Jiang *et al.* [A6] proposed an incremental ensemble classification method to improve prediction accuracy for green unmanned aerial vehicles. Specifically the authors have combined a fuzzy rule based classifier with dynamic weighing algorithm to improve the classification accuracy of green unmanned aerial vehicles. The proposed model is frequently updated by incremental learning of characters of real-time stream data that can handle the concept drift caused by dynamic changes in data streams effectively.

Green and connected autonomous vehicles are the future of transportation systems, where they can play a pivotal role in reducing pollution, avoiding accidents, improve road safely and reduce the delays in the traffic. Edge computing can be used in green and connected autonomous vehicles to reduce the communication latency and for real-time predictions. However, edge computing has its own challenges related to privacy and security of the data acquired from the vehicles. To address this challenge, the study by Kumar *et al.* [A7] proposed a deep-learning and blockchain enabled secure data processing framework for an edge-enabled green and connected autonomous vehicles. In the proposed scheme, the blockchain ensures the reliability of the vehicles added into the network and the deep learning model is used to detect the intruders in the edge computing environment.

The study by Wang *et al.* [A8] proposes a 3-hop NOMA-UAV network for ground-air-ground communications, where UAVs serve as aerial relays to support two groups of ground users. The whole communication process consists of uplink NOMA communication, point to point communication and downlink NOMA communication. Considering imperfect successive interference cancellation, the theoretical expressions of outage probability for the far user and the near user are derived. Furthermore, the asymptotic behaviors for the outage probability of both the far user and the near user in the high signal-to-noise ratio regime are explored by obtaining diversity orders. Finally, the system throughputs under the delay-limited transmission mode are investigated.

The paper present a novel collaborative computational method for reliable decision-making in Intelligent Transportation Systems. The proposed method (CCM-TL) by Nguyen *et al.* [A9] exploits transfer learning for gaining and shifting computational requirements to improve accuracy. In this method, application-centric computations are performed for decision-making and thwarting replicated and false information handling. The information is computed by exploiting the previous application-accuracy knowledge segregating different inputs. This selective computation relies on current and previous information knowledge collaboratively. The learning process is responsible for shift-based validation of computation accuracy using collaborative information. Evaluation results demonstrate that the proposed CCM-TL improves by 8.5% and 4.91% accuracy and information sharing.

Deploying Connected Autonomous Vehicles (CAVs) for the purpose of evacuation could provide safe and vital lifesaving reinforcement when evacuating populations from a large-scale disaster site. Raja and Saravanan [A10] proposed a Multi-Agent Deep Reinforcement Learning based Route Planning Framework for cooperatively navigating rescue vehicles through a large disaster area. The model adopts a collaborative, multi-agent deep reinforcement learning approach to the above-mentioned disaster navigation problem that would minimize traffic congestion, optimize fuel consumption, reduce time travel and travel risk in the presence of moving obstacles.

Chen *et al.* [A11] proposed an association-learning-based model, designated Aiden, to identify the compromised ECUs on the edge of V2X communication networks. This model considers the logical association among different ECUs and is without feature measurements. Experiments on a real vehicle show the effectiveness of the proposed model."

The proposed topology and QoS-aware load balancing switch migration algorithm (LBSMT) is designed for the intelligent communication in ITS by Babbar *et al.* [A12], which has three domains(domain1.com, domain2.in, domain3.org) and each domain consists of four switches, host and controller. The threshold value is fixed for all the switches and the load of the domains is balanced by migrating the switches from the heavily loaded domain to the lightly loaded domain. The switches are assigned the weight in Kbps, therefore, the computation is executed in the intra and inter domain which calculates the distance between switches and controllers. The performance is evaluated based on the QoS metrics: throughput, response time, CPU and memory utilization which shows the improvement over the baseline studies.

Contribution by Asim *et al.* [A13] aims to save the energy consumption and tasks' completion time of multi-unmanned aerial vehicle (UAV) by jointly optimizing the trajectories of UAVs and passive phase shifts of intelligent reflecting surface (IRS)s. They claimed that with applying this approach, the system will lead to complex optimization problem as it has several optimization subproblems like optimization of deployment of stop points (SPs), the optimization of association among Internet of Things devices (IoTDs), SPs, and UAVs, the passive phase shifts of IRSs, and the trajectories planning of UAVs. The authors proposed a trajectory planning and passive beamforming algorithm with variable population size (TPPBA-VP) to tackle the complex optimization problem using four phases taking into accounts all the above optimization concerns. The results obtained by them proves the TPPBA-VP superiority over the compared algorithms in terms of reducing the sum of the energy consumption and tasks completion time of UAVs.

Cao *et al.* [A14] proposed the virtual resource allocation approach based on network slices for vehicle-assisted beyond 5G networks. This work aims to reduce the energy cost though the proposed Ener-Eff-Slice algorithm. The evaluation results clearly support the efficacy of the scheme.

Brik *et al.* [A15] addressed the challenge of service selection/consuming in vehicular fog computing, where vehicles may offer their resources as services to other vehicles. Thus, it is challenging for consumer vehicles to discover and select the suitable service provider in a urban environment, given intermittent connectivity, high mobility, and heterogeneous costs of providers. To deal with this, the authors propose a new non-cooperative game approach, called GSS-VF, to manage

service discovery and selection, while meeting both consumers and providers requirements. GSS-VF enables to identify efficiently the main conditions under which the consumers may ask for the needed services in addition to how to select the adequate provider, with respect to the consumers' requirements.

The study by Riyal *et al.* [A16] proposed a framework to improve the energy efficiency of blockchain in connected and autonomous vehicular networks by integrating it with a semi-centralized data storage approach, where the network control is kept decentralized. The blockchain-tree approach is composed of a tree structure comprising of blockchains which is based on time-based upward data propagation mechanism to optimize the architecture. The proposed scheme reduces the communication delay, reduce power consumption and ensure the sustainability of blockchain networks in connected an autonomous vehicular environment.

The study by Alghafari *et al.* [A17] studied the issue of bandwidth allocation to mobile small cells in a 5G network. The scenario they focused on was high bandwidth communication with the users who use public transportation such as train or bus. The solution they provided was tailored for communal connected vehicles. They considered a two-tier (two-hop) architecture following the Integrated Access Backhaul (IAB) concept released by 3GPP. IAB concept suggests expanding the network by breaking down long-range transmissions into multi-hop shorter-range ones which also saves nodes energy and is green. However, in IAB, bandwidth is shared between access and backhaul links which creates the so called backhaul bottleneck problem. The authors, in the presence of multiple fiber-linked nodes, formulated bandwidth partitioning as an optimization problem. They adopted the decomposition method to solve the optimization problem in an iterative and decentralized manner without relying on any central controller.

Signal planning is very important in reducing the traffic congestion, fuel consumption and also carbon emissions. To address this problem, the study by Li *et al.* [A18] proposed a multi-intersection problem for green and connected autonomous vehicular network. In this work, the authors have modeled the multi-intersection collaborative signal planning as a multi-agent reinforcement learning problem and later presented a novel actor-attention-critic algorithm to improve the efficiency of transportation and energy efficiency in connected and autonomous vehicular transportation.

The study by Razmjouei *et al.* [A19] proposed a scheduling framework that is lightweight and secured to provide personalized edge services for parking and moving electric vehicles (EV) in 6G enabled heterogeneous VANETs. In the proposed framework, an architecture based on DAD-based well protected edge computing is designed by considering wireless charging models, where several EVs in parking wireless zone are grouped into vehicle network infrastructure for completing computational services wirelessly. Through the proposed architecture, the authors have developed a collaborative computing resource allocation algorithm that helps in deciding a customized service strategy for each network to access the mobile EVs easily and in a secured manner and also to fulfill fast wireless charging depending on several computationally complex solutions available at several network infrastructures.

The study presented by Pliatsios *et al.* [A20] propose a task offloading approach for vehicular network environments that aims to minimize the total energy consumption. The proposed approach leverages the block coordinate descent (BCD) method to optimize the task offloading decision, the allocation of power and bandwidth resources, and the assignment of processing resources.

The study by Chen *et al.* [A21] proposed an end-edge-cloud architecture for the computation of task offloading that considers three methods for task computing. Firstly they used asynchronous advantage actor–critic algorithm that is based on computation offloading algorithm for the dynamically changing environment in Internet of vehicles that solves the problem of optimal offloading decisions. The proposed solution enables vehicle users to obtain computing services from the edge servers in real-time.

The study by Zhu *et al.* [A22] firstly propose a novel idea of aerial refueling, which allows a charing UAV to charge mission UAVs wirelessly in the air. In this case, the mission duration of UAVs can be significantly extended. The feasibility is theoretically analyzed. With such proposed charging scheme, the authors investigated the flying trajectory and charging scheduling of UAV-based data collection for IoT scenarios. This work provides an interesting attempt for prolonging the working duration which is critical for future UAV applications.

The study by Peng *et al.* [A23] investigated computation offloading for applications that are sensitive to delays and having reliability constraints in edge computing enabled aerial computing networks.. The authors address the issues of finite resources, probability of failures for the applications that require high-reliability.

This paper builds a secure and efficient messages transmission channel in the IoT-enabled Maritime Transportation System (IMTS). In this messages transmission channel, there is a practical "Perception-Network-Application" IMTS network structure and an efficient Identity-based aggregate signcryption scheme with blockchain. At last of this paper, Yang *et al.* [A24] also provide the detailed security analysis and performance analysis.

The paper proposes an energy consumption model to validate the cost and energy and leverage QoS in a software-defined data center in the vehicular environment. Zhou *et al.* [A25] call their method EVCT. EVCT forms a VM cluster targeting the similarity between VMs and verifies the VM deployment by representing it as a graph cutting model with the help of maximum flow and minimum cut theory. In this way, they propose an energy-efficient VM placement algorithm covering energy consumption and SLA violations in a software-defined data center.

With the rapid development of connected and autonomous vehicles (CAVs), a large number of mobile and edge applications (APPs) have been developed and deployed through green communication and networking technology. The problem of high energy consumption during APPs usage becomes serious and in this paper, the authors propose to optimize energy usage through effective APPs recommendation. Xu *et al.* [A26] find that there are hidden relationships in the content and context of APPs in green communication and networking.

The authors develop a holistic APPs recommendation framework for CAVs in green communication and networking. The developed framework is driven by machine learning, where the authors propose two joint matrix factorization models and hidden relationship mining method. The machine learning-driven models can leverage the neglected information and learn latent features in APPs recommendation for CAVs. The authors used a real-word mobile and edge APPs dataset, performed sufficient experiments and compared the framework with well-known methods. Experimental results show that the developed framework produces the best performance.

The study by Li *et al.* [A27] used probability theory to deduce the probabilities of connectivity in cognitive vehicular networks. The proposed model is used for integration of inter-cluster and intra-cluster communication in multi-hop clustering scenario.

Mondal *et al.* [A28] proposed a novel scheme, named CALM, for cache-enabled resource orchestration in a multi-sensor-cloud vehicular system. Initially, the designed scheme explores the availability of required data for provisioning vehicular Se-aaS in the ICs of the requested SCSP as well as the ICs of the other SCSPs while considering the presence of multiple SCSPs, which essentially reduces the delay incurred in provisioning services and increases the lifetime of the sensor-equipped vehicular networks. To design the scheme, the authors used the expected utility theory, while ensuring QoS requirements mentioned by the end-users. Moreover, if the vehicular Se-aaS cannot be served from the ICs, the requested SCSP identifies an optimal subset of ECs while satisfying the requirements of the received vehicular applications using a single-leader-multiple-followers Stackelberg game. The SCSP also ensures the efficient distribution of revenue and high QoS while selecting the optimal ECs.

Liu *et al.* [A29] proposed to exploit the multi-source data fusion to enhance the situation awareness of autonomous surface vehicles (ASVs), leading to the improved efficacy and safety in ASV-empowered maritime Internet of Things (MIoT). In particular, the detected vessels and synchronous positioning data are real-timely and robustly fused to contribute to an augmented reality (AR)-based maritime navigation system at the shipborne intelligent edges. It is capable of providing important information for early warning of navigation risks for ASVs. Comprehensive experiments have been performed to demonstrate the superior performance of the proposed data fusion framework under different navigational conditions.

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APPENDIX: RELATED ARTICLES

[A1] M. Li, Y. Chen, N. Kumar, C. Lal, M. Conti, and M. Alazab, "Quantifying location privacy for navigation services in sustainable vehicular networks," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1267–1275, Sep. 2022, doi: 10.1109/TGCN.2022.3144641.

[A2] B. Liu *et al.*, "A region-based collaborative management scheme for dynamic clustering in green VANET," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1276–1287, Sep. 2022, doi: 10.1109/TGCN.2022.3158525.

[A3] M. A. Hassan, A. R. Javed, T. Hassan, S. S. Band, R. Sitharthan, and M. Rizwan, "Reinforcing communication on the Internet of aerial vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1288–1297, Sep. 2022, doi: 10.1109/TGCN.2022.3157591.

[A4] M. A. Rahim, M. A. Rahman, M. M. Rahman, N. Zaman, N. Moustafa, and I. Razzak, "An intelligent risk management framework for monitoring vehicular engine health," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1298–1306, Sep. 2022, doi: 10.1109/TGCN.2022.3179350.

[A5] V. D. A. Kumar, M. Raghuraman, A. Kumar, M. Rashid, S. Hakak, and P. K. Reddy, "Green-tech CAV: Next generation computing for traffic sign and obstacle detection in connected and autonomous vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1307–1315, Sep. 2022, doi: 10.1109/TGCN.2022.3162698.

[A6] J. Jiang, F. Liu, W. W. Y. Ng, Q. Tang, W. Wang, and Q.-V. Pham, "Dynamic incremental ensemble fuzzy classifier for data streams in green Internet of Things," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1316–1329, Sep. 2022, doi: 10.1109/TGCN.2022.3151716.

[A7] P. Kumar, R. Kumar, G. P. Gupta, and R. Tripathi, "BDEdge: Blockchain and deep-learning for secure edge-envisioned green CAVs," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1330–1339, Sep. 2022, doi: 10.1109/TGCN.2022.3165692.

[A8] Q. Wang *et al.*, "UAV-enabled non-orthogonal multiple access networks for ground-air-ground communications," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1340–1354, Sep. 2022, doi: 10.1109/TGCN.2022.3152601.

[A9] T. N. Nguyen, J. Gao, G. Manogaran, R. D. J. Samuel, and M. Alazab, "Transfer learning-aided collaborative computational method for intelligent transportation system applications," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1355–1367, Sep. 2022, doi: 10.1109/TGCN.2022.3171511.

[A10] G. Raja and G. Saravanan, "Eco-friendly disaster evacuation framework for 6G connected and autonomous vehicular networks," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1368–1376, Sep. 2022, doi: 10.1109/TGCN.2022.3163764.

[A11] Y. Chen, M. Alam, and S. Mumtaz, "Aiden: Association-learning-based attack identification on the edge of V2X communication networks," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1377–1385, Sep. 2022, doi: 10.1109/TGCN.2022.3188674.

[A12] H. Babbar, S. Rani, A. K. Bashir, and R. Nawaz, "LBSMT: Load balancing switch migration algorithm for cooperative communication intelligent transportation systems," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1386–1395, Sep. 2022, doi: 10.1109/TGCN.2022.3162237.

[A13] M. Asim, A. A. A. El-Latif, M. E. Affendi, and W. K. Mashwani, "Energy consumption and sustainable services in intelligent reflecting surface and unmanned aerial vehicles-assisted MEC system for large-scale Internet of Things devices," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1396–1407, Sep. 2022, doi: 10.1109/TGCN.2022.3188752.

[A14] H. Cao, H. Zhao, A. Jindal, G. S. Aujla, and L. Yang, "Energy-efficient virtual resource allocation of slices in vehicles-assisted B5G networks," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1408–1417, Sep. 2022, doi: 10.1109/TGCN.2022.3159227.

[A15] B. Brik, J. A. Khan, Y. Ghamri-Doudane, N. Lagraa, and A. Lakas, "GSS-VF: A game-theoretic approach for service discovery in fog network of vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1418–1427, Sep. 2022, doi: 10.1109/TGCN.2022.3159034.

[A16] A. Riyal, G. Kumar, D. K. Sharma, K. D. Gupta, and G. Srivastava, "Blockchain tree powered green communication for efficient and sustainable connected autonomous vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1428–1437, Sep. 2022, doi: 10.1109/TGCN.2022.3166104.

[A17] H. Alghafari, M. S. Haghighi, and A. Jolfaei, "High bandwidth green communication with vehicles by decentralized resource optimization in integrated access backhaul 5G networks," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1438–1447, Sep. 2022, doi: 10.1109/TGCN.2022.3171509.

[A18] Y. Li *et al.*, "Multi-agent reinforcement learning-based signal planning for resisting congestion attack in green transportation," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1448–1458, Sep. 2022, doi: 10.1109/TGCN.2022.3162649.

[A19] P. Razmjouei, A. Kavousi-Fard, M. Dabbaghjamanesh, T. Jin, and W. Su, "DAG based smart contract for dynamic 6G wireless EVs charging system," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1459–1467, Sep. 2022, doi: 10.1109/TGCN.2022.3170303.

[A20] D. Pliatsios, P. Sarigiannidis, T. Lagkas, V. Argyriou, A.-A. A. Boulogeorgos, and P. Baziana, "Joint wireless resource and computation offloading optimization for energy efficient Internet of Vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1468–1480, Sep. 2022, doi: 10.1109/TGCN.2022.3189413.

[A21] C. Chen, H. Li, H. Li, R. Fu, Y. Liu, and S. Wan, "Efficiency and fairness oriented dynamic task offloading in Internet of Vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1481–1493, Sep. 2022, doi: 10.1109/TGCN.2022.3167643.

[A22] K. Zhu *et al.*, "Aerial refueling: Scheduling wireless energy charging for UAV enabled data collection," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1494–1510, Sep. 2022, doi: 10.1109/TGCN.2022.3164602.

[A23] K. Peng, B. Zhao, M. Bilal, and X. Xu, "Reliability-aware computation offloading for delay-sensitive applications in MEC-enabled aerial computing," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1511–1519, Sep. 2022, doi: 10.1109/TGCN.2022.3162584.

[A24] Y. Yang, D. He, P. Vijayakumar, B. B. Gupta, and Q. Xie, "An efficient identity-based aggregate signcryption scheme with blockchain for IoT-enabled maritime transportation system," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1520–1531, Sep. 2022, doi: 10.1109/TGCN.2022.3163596.

[A25] Z. Zhou, M. Shojafar, R. Li, and R. Tafazolli, "EVCT: An efficient VM deployment algorithm for a software-defined data center in a connected and autonomous vehicle environment," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1532–1542, Sep. 2022, doi: 10.1109/TGCN.2022.3161423.

[A26] Y. Xu *et al.*, "Machine learning-driven APPs recommendation for energy optimization in green communication and networking for connected and autonomous vehicles," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1543–1552, Sep. 2022, doi: 10.1109/TGCN.2022.3165262.

[A27] X. Li, R. Zhou, T. Zhou, L. Liu, and K. Yu, "Connectivity probability analysis for green cooperative cognitive vehicular networks," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1553–1563, Sep. 2022, doi: 10.1109/TGCN.2022.3158953.

[A28] A. Mondal, S. Misra, and G. Das, "CALM: QoS-aware vehicular sensor-as-a-service provisioning in cache-enabled multi-sensor-cloud," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1564–1573, Sep. 2022, doi: 10.1109/TGCN.2022.3174734.

[A29] R. W. Liu *et al.*, "Intelligent edge-enabled efficient multi-source data fusion for autonomous surface vehicles in maritime Internet of Things," *IEEE Trans. Green Commun. Netw.*, vol. 6, no. 3, pp. 1574–1587, Sep. 2022, doi: 10.1109/TGCN.2022.3158004.

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