Irish Interdisciplinary Journal of Science & Research (IIJSR)
Vol.4, Iss.2, Pages 26-34, April-June 2020

Resource Management Techniques in Vehicular Fog Computing: A Brief Survey

K. Sathish[1] & T. Ananth Kumar[2]

[1,2]Department of Computer Science and Engineering, IFET College of Engineering, Tamil Nadu, India.

Article Received: 12 March 2020 Article Accepted: 11 May 2020 Article Published: 14 June 2020

ABSTRACT

Fog Computing is a promising solution designed to address the delay and the overuse of radio resources required for cloud access. To reduce latency and optimize the bandwidth usage, the cloud is to be placed on the network edge. This definition has recently been applied to vehicle networks known as vehicle fog computing. The ultimate challenge to meet both communication and computation requirements are growing with the emergence of increasingly modern vehicle applications. With the breakthrough of the VEC, service providers are hosting services in close proximity of smart vehicles in order to decrease the latency of services and to improve the quality of service (QoS). Our study offers insights into this exciting new model, as well as research topics concerning vehicle information infrastructure.

Keywords: *Fog computing, VFC, Resource management techniques, QoS.*

1. Introduction

Wireless communication is information transmission between two or more points not bound by an electrical conductor. Radio is used by the most common wireless technologies. The range can be small with radio waves, such as a few meters for TV or thousands, even millions, of kilos for deep-space radio communication [1]. This includes various types of fixed, mobile and portable devices, including two-way radios, cell phones, PDAs and wireless networking. Other examples of radio wireless technology applications include GPS devices, garage door openers, wireless computer mice, keyboards and headsets, headsets, radio receivers, satellite TV, broadcast televisions and cable telephones. Research into mobile edge computing (MEC) focuses mainly on how the decision to offload tasks and the resource allocation strategy can be optimized to improve IoV efficiency. The purpose of the author's optimization is to reduce the total energy consumption and utilization resources of the device. The goal is to reduce the delay for all users and their energy usage by introducing new IoV systems and resource allocation mechanisms. Although the computing power of the MEC is strong and the number of vehicles is growing, its limited computing power is gradually overloaded, which prevents the QoS of some vehicles. At the other hand, other cars have processors with high computing power but the vehicle's processing unit is idle. Therefore, the use of these vehicles' idle calculation tools will greatly reduce the MEC's load pressure without additional use of the MEC [2]. In the parked cars, fog node and real-time computing tools can be used. Around the same time, vehicles can directly load tasks for vehicles which have idle computing resources for task processing and increase the performance of task processing. This approach is known as Vehicular Fog Computing (VFC)

[3]. VFC still faces some difficulties, however. For vehicles with idle computing power loyalty to the IoV unconditionally. However, cars are private property in real situations and require other rewards. The incentive vehicles provide computing resources, i.e. the VFC offers incentives to vehicles that supply services. Such vehicles obtain such advantages so that they can use the IoV device tools (space for storage, frequency tools, etc.). The more money the vehicles contribute, the greater the benefits the vehicles get. In an optimization algorithm for the allocation of computing resources and the discharge of tasks, the system provides certain rewards to vehicles which pay tribute to resources, but the article does not show clearly the intent of the reward. A fair incentive program is therefore required to enable vehicles to contribute resources. In the meantime, vehicles can use these incentives to swap system resources for vehicle network to boost system performance. The use of traditional offloading and allocation of resources in MEC and VFC complicating the method by using the Lagrange multiplier technique to take decisions on offloading using a game-theoretical approach and to assign resources. To raising the complexity of the system, growing work has centered on the scenarios.

Vehicle-to-vehicle and vehicle-to-infrastructure communications via Dedicated Short Reach Communications (DSRC) are available via an ad hoc Vehicle Network (VANET). VFC 's main purpose is to convey safety messages between vehicles. Vehicle ad hoc network is a series of wireless communication vehicles spontaneously forming a network while on the road. Vehicles cooperate to provide security-related information via multi-hop routes without central administration being necessary. The distribution of safety information between road vehicles helps drivers anticipate and maneuver hazardous events to prevent potentially harmful events. VANET’s goal is to provide passenger safety by exchanging car traffic danger information in real-time with timely and efficient wireless communication between vehicles. Including security services, VANET can also provide high-speed Internet access on-board infotainment facilities. VANET communication is complicated by its distinctive VANET topology and complex wireless signal environment. The movement of vehicles is subject to street maps, traffic signals, legislation and movement of the vehicles around them. The distribution of vehicles is thus highly uniform and the connectivity is highly random. Moreover, the inevitable use of the common safety control channel makes communication highly vulnerable to collisions and interference both from visible and hidden nodes. Single VANET characteristics give rise to difficult research issues in the field of the transmission and routing of information. Vehicles' ad hoc network applications vary from road safety applications directed at the automobile or driver to entertainment and commercial applications of collaborating technologies. Due to high node mobility, fast changing network topology appears to change frequently in VANET. Potentially unbounded network Size: in one city, multiple cities or even a nation, VANET could involve vehicles. Therefore, all protocols for VANET must be rendered for realistic applications. While advanced vehicle applications continue to develop, the challenges in meeting both communication and computing demands are increasingly prominent. Different vehicle systems and services remain in the design process and cannot be applied in daily life without good communication and technical help. It is, therefore of great importance to solve this problem. Current solutions, including cellular networks, roadside units (RSUs) and mobile cloud computing, are far from ideal as their implementation cost is highly dependent. Considering a large number of cars in urban areas, it provides tremendous potential and benefit to use such underused vehicle tools. We, therefore, conceive of vehicles as communication and computation infrastructures called Vehicle Fog Computing (VFC). This architecture uses a shared multitude of user customers or near-user edge devices to communicate and machine, based on efficient use of individual vehicle communication and computation resources [4]. The quality of services and applications can be significantly improved by adding the abundant resources of individual vehicles. Through addressing, in particular, four types of moving and parked vehicles scenarios as contact and computational infrastructure, we perform a systematic study of the VFC's capacities. We uncover a fascinating relationship between contact, connectivity and mobility, and we also discover the characteristics of car-parking behaviour, which benefit from understanding the use of vehicle resources. Finally, we discuss the challenges and open issues of the VFC system as infrastructure. Our analysis offers insights into this exciting new model and research topics on vehicle information infrastructures.

2. Literature Survey

The efficiency of a contact link proposed by Xiaoting Ma et al in-vehicle relay networks has a significant effect on secure and efficient communication demands. Many of the previous research centred on the effect of the relay risk on communication, while the effect of packet collision has received little attention [5]. The number of vehicles is proportional to the likelihood of relays in complex mobile situations, while the probability of data packet collision is proportional. The efficiency of communication in the relay network is impaired by vehicle density and packet collision. This situation encourages them to research networking on the basis of carrier sense multiple accesses with crash avoidance in vehicle relay networks. Next, the relationships between the density of a vehicle, vehicle speed, the likelihood of packet collisions and the frequency of relay relays are investigated. Second, due to the high-speed movement of the vehicles, an analysis model is conducted to determine the downlink efficiency in relay communication networks in view of mobility of vehicle nodes. Finally, a platoon scheme is proposed to reduce the probability of a packet collision, taking into account the vehicle density and backoff windows for 2018 vehicle-to-road communication.

Junhui Zhao et al., are a collaborative method focused on MEC and cloud computing, which offload car services into vehicle networks [6]. A problem of cloud-MEC collaborative computing offload is formulated by jointly optimizing the downloading computing decision and the allocation of computational resources. Since the problem is non-convex and NP-hard, we propose a joint offloading and optimization of resources (CCORAO) and the design of a distributed CCORAO offloading and resource algorithm for the CCORAO scheme to reach the optimization solution. The simulation results show that the proposed algorithm can effectively improve the utility of the system and its calculation time, particularly for the scenario where the 2019 calculation resources of the MEC servers do not meet demands.

VANET is hybrid in architecture and versatility, making it distinct from other ad hoc networks [7]. VANET is critical because vehicles start to have smart embedded devices on-board. Those on-board units (OBUs) include the CAPU, sensors, GPS devices, communication devices, cameras and EDR. All these components promote ITS help VANET communication. Thus the industry is improved immensely by offering facilities for cooperative driving and instruments that can help to minimize traffic congestion, prevent collisions, provide alternative route education and monitoring in a variety of fields. Vehicles have large and underused tools for computing, coordination, positioning, storage and sensing. Such computing capacities of automobiles are combined to act as an enormous farm of moving computers [8]. To support cloud computing to address these problems in full, MEC took place in academia and industry [9]. The MEC moves cloud services to the radio network (RAN) and offers cloud computing capabilities near to mobile users [10]. This will further reduce the delay and ensure that the calculation deload method is connected to high bandwidth. In addition, numerous studies have been proposed in recent years for MEC computation offloading in cellular networks. The technology focuses primarily on increasing system efficiency by optimizing the decision to discharge and allocating resources effectively [11]. Through optimizing the strategy for offloading computations and the allocation of resources, the literature reduced total costs of energy, processing and delays for all applications and users' energy consumption was minimized.

Mahmudun Nabi et al. prove that it is also NP-hard who is challenging to find a minimum cost schedule for a single job over unrelated devices [12]. We then have an absolutely polynomial-time approximation method and a greedy approximation for a single function. Such algorithms are applied to the preparation of n projects. We validate our algorithms through extensive simulations using synthesized data, as well as real data extracted from traces of vehicle mobility and grid computing. The writers proposed a distributed edition in Renowned framework for providing security protection and enhancing network performance in vehicle edge computing implementation. In [13], the authors developed a contract-based offloading program in cloud-enabled vehicle networks, optimizing the allocation of the computing resources in order to optimize the advantage of the MEC service provider. In an online vehicle setting, an efficient service delivery mechanism was built [14]. The authors in [15] proposed an efficient distributed offloading computation algorithm to enable optimal vehicle offload decisions on vehicle networks. In order to optimize the use of underused vehicle computing resources, Feng et al. proposed an autonomous vehicle edge (AVE) framework for the management of vehicles' idle computing resources [16]. Hou et al. regarded slow-moving and parked vehicles as an infrastructure to provide computer resources to computer-intensive vehicle-related computing tasks [17].

Suzhi Bi et al., proposed a Deep Reinforcement learning-oriented Online Offloading System (DROO) that implements a deep neural network as a scalable solution to learn from the experience of binary removal decisions [18]. It removes the need to solve problems of combinatorial optimization and thus significantly reduces the code complexity in large networks. We propose an adaptive procedure to further reduce the complexity, which adjusts automatically the parameters of the DROO flying algorithm. The proposed algorithm can achieve near optimal efficiency while reducing the processing time substantially by more than one order of magnitude in comparison with the current optimization methods, the numerical results show. For instance, the CPU latency of DROO is less than 0:1 second in a 30-user network, which makes real-time and optimal download feasible even in a fast-deciding environment. Methods of heuristic local search [19] and convex relaxation [20] are proposed to reduce computational complexity.

Amal A. Alahmadi et al., suggested a new method to optimize network capacity and transmission Consumed in a cloud operator's data center. The centralized cloud and/or the shaped vehicular clouds are optimally configured to minimize the overall energy usage of the centralized cloud by reducing the average workload and network traffic [21]. In addition, tasks between vehicle clouds are restricted by completing tasks. Our proposed method is evaluated using a linear mixed integer (MILP) model where two approaches to task assignment have been taken into account: a single task assignment and a distributed task. For the first approach, each function is not divided into many clouds, although in the second approach splitting is allowable. In the first approach, power usage of the centralized cloud was decreased by 45% and 60% compared to those in which all activities were assigned only to the centralized cloud. The higher energy saving for the consolidated cloud in the second approach is because the vehicle clouds have a higher operating load than the one-task solution, averaging 37 percent more workload.

Xiaojuan Wei et al. define the model of the offloading system and have an innovative architecture called "MVR" which contributes to mobile edge computing offloading [22]. The thesis on joint energy optimization between battery-enabled RSUs and EVs remains vacant. In order to meet both the required service needs of EVs and achieve Nash balance on the advantages of both EVs and RSUs, we have built an intelligent IEAF energy harvesting system based on V2I communications.

Zhaolong and Ning et al., proposed a technique for achieving network response in real-time and place. Since the concepts and usage case of VFC is in the initial phase, this article initially developed a three-layer VFC model to enable distributed traffic management in order to minimize the time to respond to events collected and reported by cars throughout the whole of the city. Our model is validated by a real-world taxi trajectory performance analysis [23]. Finally, certain research challenges and open issues are summarized and emphasized for VFC-enabled traffic management. Moving vehicles is used to facilitate cloud computing applications for terminals. If the cloud is overloaded, the resources available for resource consuming computing in vehicles can be scheduled to reduce the process delay. The VFC definition was implemented in [24], using both stationary and moving vehicles as device and communication infrastructures. A quantitative analysis was conducted on fog capacity and the relationship between contact efficiency and capacity and mobility of vehicles.

In filling the gap, this study evaluated the collaboration between cloud computing and MEC, including the impact of car speed on the offloading calculation scheme to design a collaborative calculation offloading scheme in the vehicle network for a cloud-assisted MEC. This survey reveals the major drawbacks of vehicular fog computing, such as the utilization of resource is inefficient. The Latency is high while sending messages. The Communication made is not reachable to all vehicles and Offloading is not done in the peak time.

3. Conclusion

The main objective of this survey is to review the resource management techniques in vehicular Fog Computing, between fog nodes (vehicles) and the base station and to minimize confusion and discharge vehicle collisions when vehicles simultaneously unload tasks. The aim of VFC is to use certain notifications, like the spread of alert messages, to report an accident between cars to reduce the likelihood of a collision. A key aim of VFC is to improve road safety through the use of wireless communication and internet. The drawbacks are revealed above and further it can be modified for better results.

References

1. Das, Manoranjan, and Benudhar Sahu. "Effect of Buffer Size on Performance of Wireless Sensor Network." Advances in Intelligent Computing and Communication. Springer, Singapore, 2020. 432-437.

2. Rahman, Anis Ur, et al. "Context-aware opportunistic computing in vehicle-to-vehicle networks." Vehicular Communications 24 (2020): 100236.

3. Ning, Zhaolong, Jun Huang, and Xiaojie Wang. "Vehicular fog computing: Enabling real-time traffic management for smart cities." IEEE Wireless Communications 26.1 (2019): 87-93.

4. Hoque, Mohammad Aminul, and Ragib Hasan. "Towards an Analysis of the Architecture, Security, and Privacy Issues in Vehicular Fog Computing." Proceedings of IEEE Southeastcon. 2019.

5. Ma, Xiaoting, et al. "Carrier sense multiple access with collision avoidance-aware connectivity quality of downlink broadcast in vehicular relay networks." IET Microwaves, Antennas & Propagation 13.8 (2019): 1096-1103.

6. Zhao, Junhui, et al. "Computation offloading and resource allocation for cloud assisted mobile edge computing in vehicular networks." IEEE Transactions on Vehicular Technology 68.8 (2019): 7944-7956.

7. Gupta, Shashank K., Jamil Y. Khan, and Duy T. Ngo. "Clustered Multicast Protocols for Warning Message Transmissions in a VANET." 2019 IEEE Vehicular Networking Conference (VNC). IEEE, 2019.

8. Sun, Peng, and Nancy Samaan. "A Novel VANET-Assisted Traffic Control for Supporting Vehicular Cloud Computing." IEEE Transactions on Intelligent Transportation Systems (2020).

9. Li, Hongjia, et al. "Moving to Green Edges: A Cooperative MEC Framework to Reduce Energy Demand of Clouds." 2019 IEEE Globecom Workshops (GC Wkshps). IEEE, 2019.

10. Aliyu, Ahmed, et al. "Cloud computing in VANETs: architecture, taxonomy, and challenges." IETE Technical Review 35.5 (2018): 523-547.

11. Al-Badarneh, Jafar, et al. "Cooperative mobile edge computing system for VANET-based software-defined content delivery." Computers & Electrical Engineering 71 (2018): 388-397.

12. Nabi, Mahmudun, et al. "Resource assignment in vehicular clouds." 2017 IEEE International Conference on Communications (ICC). Ieee, 2017.

13. Zhang, Ke, et al. "Delay constrained offloading for mobile edge computing in cloud-enabled vehicular networks." 2016 8th International Workshop on Resilient Networks Design and Modeling (RNDM). IEEE, 2016.

14. Wang, Ruhai, et al. "Optimal RTO timer for best transmission efficiency of DTN protocol in deep-space vehicle communications." IEEE Transactions on Vehicular Technology 66.3 (2016): 2536-2550.

15. Ranadheera, Shermila, Setareh Maghsudi, and Ekram Hossain. "Mobile edge computation offloading using game theory and reinforcement learning." arXiv preprint arXiv:1711.09012 (2017).

16. Feng, Jingyun, et al. "AVE: Autonomous vehicular edge computing framework with ACO-based scheduling." IEEE Transactions on Vehicular Technology 66.12 (2017): 10660-10675.

17. Li, Liang, Yunzhou Li, and Ronghui Hou. "A novel mobile edge computing-based architecture for future cellular vehicular networks." 2017 IEEE Wireless Communications and Networking Conference (WCNC). IEEE, 2017

18. Huang, Liang, Suzhi Bi, and Ying Jun Zhang. "Deep reinforcement learning for online computation offloading in wireless powered mobile-edge computing networks." IEEE Transactions on Mobile Computing (2019).

19. Mavrovouniotis, Michalis, Felipe M. Müller, and Shengxiang Yang. "Ant colony optimization with local search for dynamic traveling salesman problems." IEEE transactions on cybernetics 47.7 (2016): 1743-1756.

20. Fazelnia, Ghazal, et al. "Convex relaxation for optimal distributed control problems." IEEE Transactions on Automatic Control 62.1 (2016): 206-221.

21. Alsulami, Osama Zwaid, et al. "Networking and processing in optical wireless." arXiv preprint arXiv:1907.09544 (2019).

22. Xu, Xiaolong, et al. "A heuristic offloading method for deep learning edge services in 5G networks." IEEE Access 7 (2019): 67734-67744.

23. Wang, Xiaojie, Zhaolong Ning, and Lei Wang. "Offloading in Internet of vehicles: A fog-enabled real-time traffic management system." IEEE Transactions on Industrial Informatics 14.10 (2018): 4568-4578.

24. Zeng, Yong, Rui Zhang, and Teng Joon Lim. "Wireless communications with unmanned aerial vehicles: Opportunities and challenges." IEEE Communications Magazine 54.5 (2016): 36-42.