ASSESSMENT OF VANET SMART & INTELLIGENT COMPUTING SYSTEMS FOR TIME-CRITICAL ACTIVITY

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ABSTRACT
The capacity of a field computer to work in tandem with a smart transportation system means that it can instantly calculate, store, and transmit delay notifications to vehicles. Conventional vehicle networks have several difficulties with resource deployment and management since they are neither scalable, flexible, or connected. Recently, cloud computing has been employed to accomplish these goals. This research presents a framework for evaluating the efficacy of cloud and edge technologies based on a wide range of criteria, which may be used to determine the best practices for automotive networks. The latency and server usage time of EC are reduced by 64% compared to cloud computing. Simulations are performed using both Edge CloudSim and Cloud Sim technologies. This broadcast saves space and resources on servers and in vehicles by making information more widely available.
Keywords: CloudSim simulation, Blind De-Convolution, Edge Cloud Sim, Edge Computing(EC), Task-Driven Learning

Introduction

In 2001, the transportation sector adopted VANETs (Vehicular Ad-hoc Networks), a kind of wireless cellular networking with several hops. Once a vehicle enters a certain range, it will connect to the mobile network automatically (etaI., 2015). Vehicles that are linked to the internet may share data about where they are and how fast they're going with one another. The two main categories of VANET communication protocols are V2V & V2I. These transmission and reception methods also allow for mobility.

There are compute, communication, scalability, adaptability, and intelligence issues with the current VANET architecture (Gupta & Chaba, 2014). VCC was created so that VANETs may get computing resources from the Cloud while also benefiting from Cloud Computing's advantages (Azees, Vijayakumar, & LJ, 2016). Improved processing performance and resource usage in-vehicle are achieved (Hassan, Hossain, & Atiquzzaman, 2016). The traditional methods are too much for RSUs to handle, hence there are long delays, therefore. This research led to the development of the Edge- Computer (EC) idea, which aims to address the problems of low processing efficiency, slow response times, and high resource consumption. Edge computing (EC) is distinguished by several features, including low latencies, geo-distribution, diversity, portability, location-awareness, and actual real-time based interaction (Jain & Jeyakumar, 2016). This study advocated for edge-based distribution as a method to improve the efficiency and scalability of VANETs. Most importantly, the research highlights the security problems and vulnerabilities associated with edge computing (EC).

We begin by looking at what has already been written on MEC integration in automobile networks. The proposed system includes two crucial VANET-based applications, such as travel comfort and traffic safety, to address scalability and efficiency.

In addition, we will go through the system based on the simulation method we used to assess the performance of our system during the application phase.

The remaining details are presented in the following sections. In Section 2, we'll talk about some related research on edge computing (EC) and the cloud; in Section 3, we'll outline and expand on some potential solutions. In the last section, we evaluate and discuss the experimental findings. The last section addresses implications for the future. The list of sources is included at the end of the article.

Literature

The state of the art in studies examining the integration of MEC in vehicular communications, as well as their potential applications and challenges. All the necessary concepts, applications, and frameworks for calculating the fog were laid out by Chaba. (Zhu, & Wang, 2016). Fog decreases computer congestion and latency in networks when cloud computing is pushed to the networks' edges. Fog computing is used to manage a decentralized and virtualized infrastructure. It connects the sensors and cloud computing data centers.

In certain use instances, the fundamental requirements of cloud computing cannot be met (Karimireddy & Bakshi, 2016). Using the EC model, this research explored how to extend cloud security to the network's periphery. The present research identified security-related dangers, practices, benefits, and drawbacks (Kaur & Malhotra, 2015) provided an example of the use of fog computing to intelligent transportation systems. That's the pinnacle of intelligent transportation use cases in VANET. Existing research has shown that cloud computing is inefficient for various VANET applications due to latency-sensitive needs and vehicle mobility. Here, an agent-based application strategy was used to implement a decentralized transport network.

For VANET security to be guaranteed, it is necessary to identify adverse communications, which point to undesirables with bad characteristics. This research (Lo & Tsai, 2016) offered a unique method for evaluating negative feedback based on meet-tables and cloud computing. Meet-Fog is the best choice for maximizing data storage efficiency in hybrid cloud and edge environments. Extensive information on the Fog and the technique used in meet-design is provided. The Meet-Fog models are therefore very precise and comprehensive. For the cellular vehicle network, Huang (Liang & Sheen, 2012) developed a revolutionary computing-based edge approach (connections). The available literature addresses the issues of complete service delivery and reduced failure rate. We're interested in Mobile Edge Computing Servers (MECS) that can be linked to a collection of base stations over a radio-access network. It also effectively manages a radio-based network and performs a variety of vehicle-related activities and services. To do this, the MECS employs traffic scheduling techniques and network slicing.

Because of the superior performance and accessibility of the MEC server, a specialized network service built on MEC was also implemented. As the MEC server's capabilities increased and road information became more readily available, a MEC-based, individualized network service was developed to take use of these new capabilities and improve reliability, portability, and usability.

Edge computing (EC) was suggested to provide flexible deep learning for the Internet of Things. There are several problems with the current methods to IoT edge computing (EC). In this study, we combine edge computing (EC) with deep learning to provide highly adaptable edge computing (EC). In this work, we employ a mix of agents and a novel offloading technique to boost the performance of IoT-deep learning using edge computing (EC) (EC). The suggested architecture has a more sophisticated IoT system paradigm, more adaptability, and functionality that is centered on the user (La & Cavalli, 2014). Intelligent transportation systems benefited from Hussain implementation of the deep learning paradigm, which allowed for reliable analytics to be provided at the network's periphery. Data was computed at the level of smart sensors at the roadside to address and overcome worries about dependability and ITS delays.

Intra-vehicle computers might implement a distributed edge computing (EC) architecture using deep learning techniques and ITSs. The proposed deep learning method acts as a reservoir for ITS edge analytics by equipping ITS devices with superior signal processing capabilities. Using edge computing (EC), Jalali were able to transmit safety signals across diverse VANETs (Malik & Panday, 2016). They developed broadcasting methods for safety-related messages based on the aforementioned premise. While the NRCR (Non- Redundant Communication Range) forms the basis of the proposed system, the scope of the research was limited to highway environments (NRCR). The proposed method for decentralized broadcasting makes use of local topological information to ensure that signals are sent securely and may be received with ease in both dense and sparse VANET settings (Mishra, Singh, & Kumar, 2016). The proposed approach was shown to be effective.

Mishra, Singh, & Kumar (2016) described an approach to optimizing message (i.e. information) cover in communications between urban vehicles. Until recently, 1-D V2V (Vehicle-to-Vehicle) communications scenarios have been the exclusive focus of attempts to expand road network coverage. To get the most out of the study, it was done in a two-dimensional setting. The most popular method is the Message Coverage Maximization Algorithm (MCMA). It examines the difficulties encountered while trying to get the best possible message coverage and roadside unit performance. Consideration was given to the volume of traffic on each route. For time-delay constraints inside, the results show that the suggested method enhances traffic flow following an accident. For more processing power, Mahmud (Prokop, 2011) suggested a vehicle-based edge computer (VEC). To illustrate the VEC architecture, this research makes use of services, applications, and communication in smart vehicles. Any technical questions that may arise with the VEC architecture may be answered by them.

Rajput, Abbas, Wang, Eun, & Oh (2016) presented fog-computing for real-time based VANET applications. In VANET systems, the vast amount of data generated by the roadside network platform requires the use of more conventional data storage, network, and processing facilities. The Virtual Control Node (VCC) serves as a data center, computing facility, and networking hub for VANETs. In this research, we presented a fog-computing-based application that uses VANET methods in real time. In their discussion of the 5G vehicle cloud computing system delved into the topic of motilities management (Sallam & A. 2015).

The level of the services offered by each vehicle varies. On the other side, attention must be paid to provider regulations and user requirements. This study developed a novel approach to VHO (Vertical Handover) management for 5G-VCC networks. The speed of the vehicle and other network elements were considered while deciding on a network. There are many different aspects of a network that may be measured, such as throughput, latency, packet loss, and jitter. Attributive language features and variable-order-of-operator processing (VHO) are used in the suggested method. The 5G-VCC system, which utilizes 3GPP Long Term Evolution (LTE) for both fixed and mobile applications, is where the suggested method finds its home (WAVE). In this approach, the proposed method improves the optimal connection score. Recent challenges with authentication in V2X communication were studied (Sari, Onursal, & Akkaya, 2015). Investigating V2X services and V2X communications was the focus of this study. Then, the benefits of V2X architecture and cellular networks were analyzed. They discussed several V2X dangers and existing V2X communication methods on the cellular network. An original vehicle sensor layout was proposed to track traffic conditions (Shakyawar & Tiwari, 2016). This approach might be used by MSaaS to determine whether they should provide their mobile devices' sensing capabilities as a service to other users. The results of the testing reveal that accuracy increased to 81.7%, network load decreased by 73.8%, and response times were cut down by 60.3%. Broadcasting cloud-based toll payment messages over VANETs is now possible (Shao, Lin, Lu, & Zuo, 2014) . The message covers a wide range of topics, such as travel delays, amusement, emergencies, and location-based tools and services. The secure authentication method advocated for uses encryption and decryption and is based on route authentication.

Certificate overhead management was adjusted to provide for more nuanced message distribution by allowing cloud architecture to provide integrity, verification, and secrecy. New objectives, such as learning how technology and performance interact when the tasks are similar and different, will be developed because of literature studies. According to Shakyawar & Tiwari (2016) MSaaS entails a mobile device with powerful processing capabilities and a base station that acts as a data relay node.

Objective

The objective of this research paper is to provide a mechanism to evaluate the efficacy of cloud and edge technologies based on a wide range of criteria, which may be used to determine the best practises for automotive networks. The research highlighted in this work also establishes the reduction in latency and server usage time of EC in comparison to cloud computing. This research output also saves space and resources on servers and in vehicles by making information available more widely.

Resource Allocation

Overview

In this article, we examine the many methods that have been developed for allocating resources in DSRC-based vehicular networks. These methods have mostly concentrated on various methods of allocating MAC parameters, channels, and rates. In what follows, we use these definitions to group together various strategies for allocating DSRC network resources causing a drastic slowing down of the network's performance. For instance, a fast vehicle's throughput could suffer in comparison to a slow vehicle's because the latter spends more time in the RSU's coverage area, giving it a greater opportunity to connect with it. To improve DSRC networks' dependability, throughput, and fairness, a number of research have focused on optimizing the MAC parameters involved. Specifically, by accounting for the average speed of cars in the network, an optimum choice on the minimal contention window (needed for every vehicle) has been established. To prove the efficacy of their approach, used a custom-built event-driven simulation software (written in C++) to model a V2I network with an IEEE 802.11p-based MAC layer and an 802.11a-based physical layer (Noori & Valkama, 2013). The average speed of the slow car was set to 60 kilometers per hour, while that of the rapid vehicle was set to 120 kilometers per hour. The data transmission ratio is shown to rise with increasing mean vehicle speed for the default DSRC method. Indeed, in this instance, the data transmission lowers because the residence time of slowly moving cars inside an RSU's coverage area diminishes. However, the contention window distribution approach described by Harigovindan. keeps the data transfer ratio roughly flat by giving slower and faster cars an equal opportunity of communicating with the RSU. Keep in mind that if there are a few fast cars and many slow vehicles, the suggested strategy may be unfair to the slow vehicles since they are more likely to incur greater losses. Furthermore, when one lane of a highway is filled by a platoon of slow-moving cars and the next lane is occupied by a constant stream of quicker vehicles, the suggested approach would certainly produce injustice.

Rossi. (Vijayakumar, Azees & Deborah, 2016) presented a stochastic model to determine the maximum contention window based on the number of cars in the vicinity, with the goal of optimizing throughput among nearby vehicles. Network Simulator 2 (NS-2) simulations were run by the authors of (Vijayakumar, Azees, & Deborah, 2016) to test the validity of their proposed model for a road network with a single-lane, one-way road, and a total length of 5 kilometers. To run the simulation, it was assumed that each vehicle could roughly count the number of others nearby within interference range. Set the route loss exponent to 4 and adjust the transmission range to 100 meters.

To enhance the functionality of networks in highly mobile settings, two different dynamic Contention Window (CW) allocation strategies are presented in [49]. Both schemes dynamically allocate the contention window depending on the number of neighboring cars; the first uses a p-persistent based technique (Xiangjun & Tigang, 2010) and the second adapts the window based on the relative velocities of the other vehicles. All cars were equipped with the same 802.11p MAC settings, and speeds ranged from 60 to 120 kilometres per hour. Delivery rates and throughput in the network are shown in a comparison of their suggested designs. It has been shown that both approaches result in lower rates of packet collisions, leading to improved performance. Furthermore, each scheme offers improved performance in a particular setting. When there are a lot of cars in a network, for instance, the first method has a higher delivery ratio of packet. When the number of cars exceeds 80, the second approach provides superior network performance.

Designation of Critical Communications Paths

Orthogonal frequency bands are used by DSRC/WAVE to allow for multi-channel operation while still allocating an equitable number of channels to each message. Low latency, extreme reliability, and high priority processing is required for emergency communications. It is proved that its emergency PDR is greater than WAVE's PDR.

Assigning urgent messages to reserved channels in a high-traffic environment is a key reason why DMAE surpasses WAVE in delay performance.

Assigning Prices

Communication based on IEEE 802.11p offers various MCS, allowing for data speeds anywhere from 3 Mbps to 27 Mbps. Table II displays the transmission ranges and data rates (nominal and average effective data rates) for each MCS. Previous efforts on vehicle communications frequently assume a constant MCS for the sake of simplicity. Constant MCS may not be appropriate for varying traffic circumstances throughout varying stretches of road, which might degrade communication performance if used. When all nodes share the same channel conditions, the IEEE 802.11 MAC protocol guarantees that each node will have an equal chance to transmit. However, throughput-based fairness will result in significantly decreased aggregate throughput while operating in a variable channel situation and a crowded network. The scheme's overall throughput requirement is met by combining the transmission rates of many vehicles into a single channel, while the fairness criterion is met by regulating the sizes of the groups. Through the elimination of performance anomaly phenomena caused by different transmission rates in IEEE 802.11p multi-channel networks, system throughput is increased when OBUs with comparable transmission rates are grouped together. To reduce the amount of time it takes for the system to respond, the authors developed a network coding scheme based on a dynamic threshold. This scheme ensures that the most urgent request is always included in the coded packet and that the packet's transmission time is never longer than the deadline for the most urgent request. The length of time it takes to send a coded packet 4 relies on its size and the mode of coded signaling (MCS) chosen to provide the greatest data rate possible while still satisfying all requests contained within it. As a means of testing the efficacy of the suggested approach, we simulated a multi-RSU vehicle network in a city grid. We have used CSIM19 to develop the simulation model and have run simulations using the default parameters of MAC layer standards and the IEEE 802.11p PHY.

In order to simulate the vehicle's maneuverability, a Manhattan mobility model was used. Both response time and percentage of missed deadlines were used to evaluate the effectiveness of the proposed method. As can be seen in Fig. 5, there is a clear performance gap between the two MCS types when fixed MCS is used.

Data from simulated deployments demonstrates that the dynamic MCS scheme may enhance the system's capacity to serve requests on demand and decrease response times.

Data Analysis

An important aspect of 5G and later communication systems is their ability to serve a wide variety of vertical applications and use cases. Smart cities and homes, e-health, smart manufacturing, smart refineries and chemical plants, and Cellular V2X are all examples of vertical use cases (C-V2X). Many mobile operators have lobbied for C-V2X as part of the expansion of 5G NR and 3GPP's LTE (Zhang & Sun, 2016) because of its potential to provide a more profound and pervasive use of wireless communications.

Edge computing (EC) and cloud computing are the two main parts of the network paradigm that the VANET concept separates apart. The components of a VANET network are vehicle nodes, RSUs, and management authority. When vehicles (like cars) are in motion, the RSUs connect the cloud's infrastructure with the vehicles themselves by acting as gateway terminals. Fixed RSUs may be equipped with edge computing (EC) software, turning them into network nodes that serve as the network's front line and delivering edge-based services. Located on the farthest reaches of a network, edge devices are tiny data processing and storage units. Vehicles travelling via these servers will be required to register, and all edge servers will get the information (data) that has been registered or shared, enabling registered vehicles to move without re-registering thanks to edge device caches. Edge Sim and Cloud Sim are two examples of simulation technologies that may be used for this purpose. Beacon signals sent out by vehicles will be received by the closest edge server.

Metrics of performance	Edge	Cloud
Service-Time(ST)	1.052393	0.851403
The time of processing i.e. the time of processing(PT)	0.994514	0.175687
Delay	0.058764	0.675619
Server-Utilization(SU)	0.143946	0.06198

Table 1.System characteristics and simulation methods employed in the proposed system are listed

S No.	Simulation-Parameters	Tool-used in research /Values
1.	3-edge servers are configured.	Edge Sim software tool
2.	The cloud server's configuration	Cloud Sim software tool
3.	Vehicle count	25
4.	Simulation Time Vehicles' Average Speed vehicles' Registration Id	SC 01 to SA25
5.	Area for practice.	95 sec's
6.	The protocol is used for communication and routing.	95 to 150 kmph
7.	Designing and deploying a VANET topology	1000 m X1000m
8.	GUI	The LTE in both cases, V-AODV
9.	Three edge servers are configured.	Vanet Mobi Sim, & NS-3
10.	The cloud server's configuration	Java Programming Language

Table 2: Comparison Performance Measures were Compared

Performance measures	Edge	Cloud
Service-Time(ST)	1.202810	0.808413
The time of processing i.e. the time of processing(PT)	1.149105	0.157584
Delay	0.053613	0.650777
Server-Utilization	0.24385	0.071583

Table 3: Comparison Performance Measures were Compared.

In order to determine the shortest path between two roadside units, workers consult the MCMA lower limits and a pseudo ID stored on the closest edge server once every ten seconds. It's helpful for neighbours to know the present state of network topology responsiveness. When a car uses a Gateway Terminal, it is able to relay its destination and route information to the cloud. Each edge node stands for one of the cluster's leaders. All of the edge nodes collaborate to provide safety and other data about vehicles that leave their respective clusters at a given time. By disseminating this data, we can relieve the load (overhead) of communities close to the point of arrival for the vehicle. When all of the edge servers share vehicle data, it reduces the chaos and duplication of data storage on the server and vehicle sides. Just one milligramme Vehicle networks are employed in both cloud computing and edge computing because to their high bandwidth, computation, and storage capacities (EC).

The VEC receives 1.09 percent of the system's service time (ST), 0.98.8 percent of the processing time, 0.07 percent of the delay time, and 43.9 percent of the server system's utilisation.

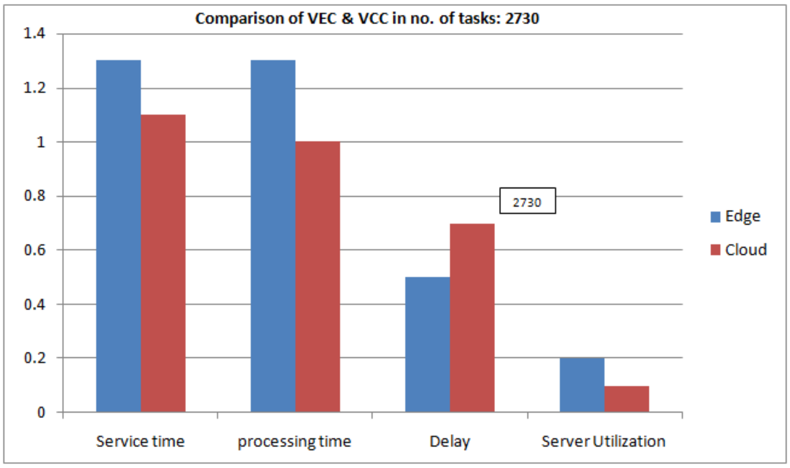

Fig. 1: Graph Showing VCC and VEC Task Comparisons

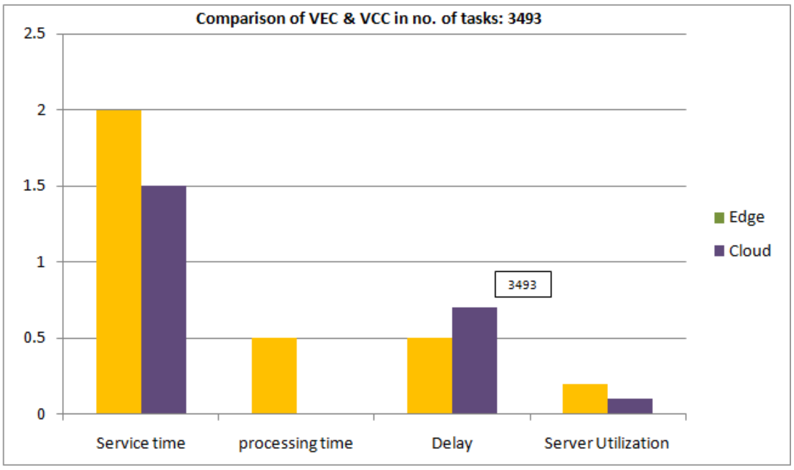

Fig. 2: Compared Graph Plot of VCC and VEC

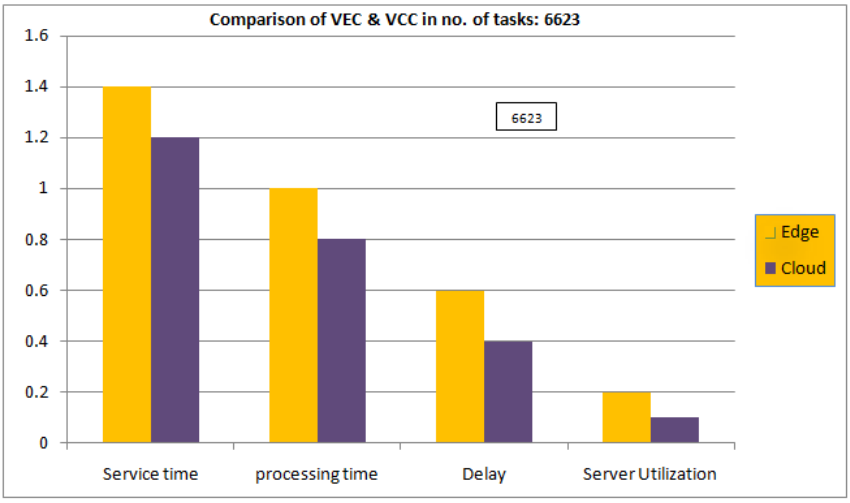

Fig. 3 shows a comparison between VEC and VCC across 37 different occupations using 6223 vehicles.

The time of service from the system, the time of processing, the lowest time of delay, and the maximum server utilisation are all best achieved using edge computing (EC) for 6223 workloads.

On display in Figure 3 are the evaluation parameters that were used to compare VEC and VCC over a variety of tasks (6223), using 37 vehicles. Edge computing (EC) was shown to have the quickest service time (ST), processing time, lowest delay time, and greatest server utilisation for a total of 6223 applications.

Figure 3 compares VEC and VCC in a variety of vocations (6223) with 37 cars. For 6223 workloads, edge computing (EC) offers the quickest time of service from the system i.e. time of service from the system i.e. time of service from the system i.e. service time (ST) , the time of processing, lowest time of delay, and highest server utilization.

Metric of performances	Edge	Cloud
1.Total time taken for service	1.043774	0.846578
2.The time of processing i.e. the time of processing(PT)	0.985218	0.122877
3. Time of Delay	0.05855	0.723701
4.Server-Utilization time	0.391902	0.1162

Table 4: Comparison of Performance Metrics.

Conclusion

After evaluating alternatives, the transportation sector has found that edge computing (EC) technology reduces lag time for applications running in vehicles' cloud networks and boosts server capacity for such apps. VANETs. Extremely high data transfer rates, low latency, and awareness of the surrounding environment are all advantages of vehicle-based networks. We investigated the availability of traffic data using virtual area network (VANET), cloud, and edge computing (EC) technologies. The simulation results were tabulated based on how the system proposed here was implemented using the Edge Cloud Sim and Cloud Sim modules. The results demonstrated that the proposed system outperformed cloud networks on all of the evaluated metrics, including latency and server utilisation. When comparing service and processing time, cloud networks are superior than their more conventional counterparts. If 5G is used for transportation networks, the system's edge-computing capacity may be increased to cut down on processing times and delays. Although edge computing (EC) won't be able to fully replace cloud networks, it will speed up both processing and communication.

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