International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 05,
2019 ISSN: 1475-7192

# A Review on IoT Based Vehicular Edge Computing

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***Abstract*---*Vehicular Edge Computing (VEC), a brand new network paradigm, has recently been introduced in the brand new system to further strengthen its storage for computing. The obstacle to compliance with certain computational and communications specifications is prominent along with the beginning of modern vehicular applications. With all the success of VEC, the sponsoring services of the service provider close to both smart automobiles, such as lowering latency and improving the high-level quality of service (QoS). The VEC structure combined with every notion of software, its own services and the automobile, is exemplified by this paper. This paper have assessed and described all the most recent and relevant solutions. This paper nail forward research problems and discard slightly. This paper enables readers to gain a better understanding of the field, but it also provides guidance for one area of research within the VEC.***

***Index Terms*---*QoS, IoT, Fog computing, Cloud Computing, Internet of Vehicle, Vehicular Edge Computing (VEC).***

## I. INTRODUCTION

Electronic devices expand their storage to develop information and accumulate a large number of facts, from the dimensions of all-natural events to human behaviour. With the planned growth of the IoT platform, the majority of items will be included in the forecast in the predictable future. The integrated connection between the world's web pages demands that an enormous amount of data be transferred, stored and processed, setting a path for years of discovery linked to such IoT conditions.

Cloud computing has developed and transformed into a user-friendly system for the most common software to supply and process information. IoT gadgets typically use cloud computing systems to supply information and processing, and to produce knowledge and information. On the other hand, however, due to this simple model and the ability to cover zero preliminary funding costs, the tremendous use of Cloud Computing has been a sign of the rapid advertising period. The very same lot of acceptance has put some constraints on this model, for example by meeting all the specifications of a number of different application styles. For example, very low latency and mobile software in real-time for example. Cloud servers were often located logically or physically by your cloud users, suggesting that data and communications transportation go through various jumps that present faults and absorb network bandwidth and core elements [1], [2]. Cloud computing and increasingly advantageous software and a lot of capabilities have been introduced. Computing structure for edge application has started appearing recently, improving features such as reaction time and decreasing the usage of bandwidth. By combining the running storage with the untreatable out of the



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**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

nucleus of smaller, more localized software, even fog computers are a paradigm, allowing heterogenic requirements of the computer structure of small and massive software to unite instruments outside of the boundary of their systems, as well as from your device. Within this paper, this paper aim to identify the main features of the cloud computing mix and to identify the cloud computing that is acceptable to various kinds of Web-regulated software [3]. In the fields of data (metropolitan area, urban measurement (and business 4.0) this paper talk about the complexity of that IoT fog cloud platform (product & solutions, source allocation and optimization, electrical supplies, information and region, federation devices) from your network (processing and media protocols and system such as 5 G supports) this paper talk about the application.

IoT, Fog, and Cloud: Basic Definitions:

The vocabulary and theory of the three aspects of that eco-system of IoT-Fog-Cloud are presented here.

**Internet of Things (IoT)**

The literature includes predictions about the Internet of Things (IoT). If there is a lack in consensus regarding IOT then the number of devices is around: in a few years ' time factor" will possibly be added. The devices may consist of virtually anything with an integrated microcontroller and communication capability (e.g. a pair of detectors and/or actuators in a symmetrical way) [4], [5].

This unprecedented quantity of devices contributes to an unparalleled amount of processed and transmitted information. Greater than these, info-communication protocols, vitality prerequisites, potential calculations, freedom, etc. are exceptionally heterogeneous. For this reason, the direction of IoT gadgets is difficult throughout the length of the information processing and communication stack.

Unprocessed data from the IoT may not be helpful as a whole. Such extraordinarily large data collections require important processing and understanding guidance for providing some useful information. IoT application aims to achieve this strength: to transform the accumulated data into a real understanding of the data. Though a server of new application is supported by IoT, it is also a result of more heterogeneous applications: separate application has various requirements that really ought to be fulfilled using IoT equipment using their calculating platform. This paper present two calculation paradigms in the next sections, which can be utilized jointly to meet IoT application requiremen ts: fog and cloud computing [6].

**Cloud computing**

In the last 10 years, cloud computing is stable. Due to the lively features like durability and pay-per use, many applications have become widely used as a paradigm in computing. Virtualization is only one of the columns for cloud



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

servers in order to be able to provide those capabilities. Virtual containers and machines allow suppliers to discuss these calculating tools with you, which usually include large data centres, one of the end customers and which leads to logically dispersed platforms for each individual renter.

Cloud servers based on both basic designs, in particular, Infotainment as a service (IaaS), Agency system (PaaS) and Storage as a service (SaaS) calculate on-demand calculations. In fact, IaaS provides a service with a computing infrastructure that allows the user to access and manage computing; in addition to the necessary application databases and libraries, PaaS provides both applications with a stage for development together, while also SaaS provides applications with an infrastructure of your own cloud provider to successfully reduce. A variety of cloud services have emerged triggering the concept of an organization (XaaS) [7], [8].

Cloud suppliers can also be branded with personal, hybrid vehicles and network clouds according to their deployment model. Manifest clouds would be so open to the general public that they usually charge everyone with an on-line relationship on the pay-per-use basis. Many unread end users (e.g. a company or college) have been restricted to private clouds. Hybrid clouds are indeed a composition of public and private cloud computing tools, which often match the energy and prevent the decision for the summit to spend in advance. The network clouds, like virtual grid computing associations, are a collection of private clouds to address tools.

Cloud Services are also provided on the basis of the Service Level Agreement (SLA). This defines the services provided and how the consumer really needs to be charged for using the services of cloud server. The common case is that a pay-per-use unit is used precisely wherever a charge takes place by the selected time area (e.g., hour digital server), the quantity of info (e.g. information transfers from suppliers or the volume of info saved), or by the number of requests.

Such faculties build properties that attract customers in the cloud, such as supplies / de-provisioning, mobility, omnipresent availability, lower upfront investment costs as a swap for more operational expenses and speedier promotion times [9]. The duration of this paper explores how oceans can fulfil a portion of their application requirements in the IoT picture. This paper also share how precisely Snowball computing can be combined with Cloud in the next segment, which meets a wide range of IoT application requirements.

**Fog Computing**

The computational storage in the edge is enhanced by the hardware development of all personal devices. The computer power state with the development of computer paradigms for edge systems that indicate the quality of the application and storage of data. The design of the components has also allowed for a proportional reduction in the number of portable devices, which are able to handle application with decent sophistication and service calibration



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

(QoS) with adequate component energy. Also adding advantage devices to method infrastructure objectives and containing various titles from the literature that reveal features of this method. By way of reference, not long ago the name Cell Edge Computing was transformed by the European Telecommunications Standards Institute (ETSI) into a calculating multi-access edge while retaining exactly the same acronym of MECH. This move was an attempt to provide a standardized structure that transcends the operator's requirements. The aim is the same: to present cloud-like features within this network, but wireless communication systems include them. Due to the wide range of new layouts IoT and also Vehicle-to-all networks (V2X) could be executed as an example. In addition to providing a variety of calculating storage (fog nodes, pairs or micro-information centres), which include the edge and also the cloud, fog computing provides advantageous equipment and cloud computing [10], [11]. It is estimated that the greater the system hierarchy, the greater the fog node (couple or microscope), also the more expensive it is calculating storage because it is necessary to offer the convenience of a greater pair of end-users downward at expectations. This capability could be sprinkled inside the system, either the system centre in the input problem and so forth. In fact, the less centralized the gadget has, the closer it is to that gain, the fewer communication defects that are added to beneficial devices (for example, touch-screen phones, IoT sensors, cars, drones etc.).

**Smart Vehicular Layer**

Automobiles are more likely to talk, sell on-board suppliers and extend storage. The luminous surface consists of a number of vehicles that are danger and show devices in the entire radio system. For information from embedded detectors, GPS cameras, radar, LIDAR and other automobile devices, the light-weight stratum should be confident. The accumulated information might be transmitted as an input for many services within the program layer the Edge Cloud layer or storage functions. With wise vehicle lying, it is possible that the vehicle or truck will have the capability to store, interact, understand and research that the engine manager aims. It will probably help vehicles to use products and suppliers from various vehicles since smart vehicle computers even supply discharge centres as well as vehicles offered at their system edges and provide all the professional services required by independent vehicles [12].

This layer can perhaps improve the feeling that drivers and passengers may not only feel surrounded but also act. The most important part of the layer is that a vehicle or camion; vehicles are regarded as wise motor vehicles or trucks within this particular paradigm and thus are fully equipped with several latest detectors and communication gears.

**Smart Vehicle**

The vehicle that measures has space outside contact centres and will surely be able to benefit from its environment simply by drawing conclusions, so it's known as a wiser motor vehicle. An increasing the selection of wise vehicles with on-board wireless devices (3GPP, IEEE 802.11de, blue teeth, etc.) and sensor systems (radar, lidars, etc.) will boost the flow of vehicles by easily decreasing the travel time and preventing the congestion of all visitors.

Light vehicles can encourage certain apps (e.g. basic safety messages and warnings and gossip-based application,



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

etc.) even using advanced features (i.e. fact monitoring, placement advice, etc.). In the majority of cases, vehicles are constructed using on-board electrical devices in a VEC, especially OBUs, for example, the on-board radar from a wise vehicle or truck, after identifying traffic jamming, is mechanically capable of slowing down the vehicle [13]. Detectors are used in warning systems to check whether airbags were deployed during the incident. This data is then distributed within the group through V2V / V2I.

**Components of Smart Vehicle**

These devices can be connected in one way. Detectors of the vehicle to seek guidance from the driver. In higher quantity information is collected and automatically stored in a storage device for the purposes of further processing, including input detector, navigation solutions, fever, behaviour detection, and chord. The automatic conduction controller, for example, environmental detection, basic mechanical production decisions along with mechanical control, will be available independently, depending on advice. The decision is also given. The architecture of this system should be designed so that drivers can simply avoid wounds. The smart vehicle or truck is often designed with beams, microwave radars, high-resolution cameras and therefore to provide reliable and extensive surrounding information. It is also possible to use interaction and technology. Wireless transceiver: it transfers data and knowledge to both networks on one vehicle and on a truck. GPS receivers: receive information about the International Positioning System and provide navigation providers with assistance. By integrating the A-GPS system using a communicative method, despite a much less than 1 m precision, it can mechanically report the exact location of the vehicle. This can provide information on injuries and therefore facilitate the coordination of the creation of both platoons and accumulated information. Sensors: various detectors are available internally and in a vehicle, for example in the case of an ultrasonic detector based on noise waves, represented by those elements, to quantify various facets such as rate and space from the vehicles surrounded. The sound waves reflected are used to recognize the exact distance and relative speed of surrounding items. I / O port: it provides a favourable contact of the person with the human vehicle. Radars are radar and radar classifications. Inflexible cruise control procedures these detectors are already used. LIDAR: the light detection and stalks, which, in fact, include a high-quality scanning capability which, when cutting on a flat surface along with laser beams, can accurately measure the vehicle's relative space [14]. The detector uses high-speed laser beams to move infrasound light pulses automatically over a wavelength of between 850 and 950 nm. OBU: on-board appliance, equipped with an OBU, which controls the SRSUs and SMBSs, vehicle or truck, and various automobiles via a DSRC / LTE-V. LCS: The digicam sensor in the neighbourhood can be your detector which investigates your driver's behaviour, plus providing true and trusted discovery.

Technically speaking, the vehicle must be able to produce an authentic and reliable environmental understanding based on unclear and incomplete on-board sensors data. When targeted visitor analysts turn their predictable and learning-oriented solutions to deal with obstacles, a more sensitive vehicle can find a way to respond to and make a



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

decision·

**A Network of the Smart Vehicles**

The vehicle must be technically able to achieve a genuine, reliable understanding of the environment through unclarified and incomplete data from on-board sensors. A sensitive vehicle can find a way to address and make choices when targeted visitor analysts use their predictable learning solutions to deal with obstacles. Each vehicle can receive this advice using infrastructure support and application for information sharing in real life. This provides the basis for traffic and safety application. Two forms of communication exist V2V and V2I. There are two forms of communication [12], [15]. In addition, information on these comprehensive settings (e.g., advice from various vehicles alongside alternative detector gear in the ranges) may be collected from other things like vehicles, pedestrians, and on-road transport and revealed accordingly that smarter services can be provided. These solutions include autonomous warnings and warnings of collisions. In our previous step-by-step summary of fog and of enormous information significance, a kind of digital vehicle manipulation system was discussed that can help install future cities that are intelligent. Determine 4 reflects the overall smart vehicle communication process.

**Intravehicle Communication**

The word was coined to convey messages. Even the OBUs that could be set up in vehicles or trucks (i.e. a variety of detector systems offer advice such as traffic congestion (brakes, accelerator, and alternative neighbouring items).

**Intervehicle Communication**

It includes interactions on or near streets, vehicle parks and separate areas between vehicles, or between detectors and vehicles. Communication causes further issues whether the vehicles are still moving and should be allowed to interact if the vehicles have been stationary. Communication with vehicles can take place. This type of communication allows information to be shared between vehicles irrespective of infrastructure. However, communication concerns a small selection. Extra from the conversational atmosphere, an extensive analysis was vehicleried out. V2V approach to manipulate crossovers to select what needs to be moved. The procedures which ship corrections into additional vehicles were used. The strategies train other vehicles for all their injuries during V2V communication. Determine 5 reflects the communication style V2V [16]. Application such as Road Accident, V2V roadside support, which communicates to improve the vehicle system's conversation reach. When these programs are not mutually applicable, they share data between vehicles and roadside components. Motor vehicles act as intermediaries during this procedure; they are given advice and forwarded to enter this SRSU's reach.



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

**Extra vehicle Communication**

The term extra-vehicle interaction represents the contact between the vehicle as well as the surface world, that is to say, V2I (vehicle or truck to boundary nodes, SRSU, SMBS ...).

The installation of edges will guarantee a conversation with the vehicles. Even if you have any traffic or risk your flask neck and the variety of pedestrians in your way an auto can socialize in all coming vehicles. In addition, advantage computing enables the synchronization of accessible, reliable and dispersed environments with regional detectors.

V2I enables wireless data to be shared between vehicles and infrastructure (such as SRSU, SMBS, etc.). Some application requires the edge servers while the storage and processing capabilities of these vehicles are limited. In certain instances, it is expected that data will be collected as an example. Some programs can extract the congestion of visitors and climate information through V2I communication.

**Autonomous Vehicle**

With all vehicle designs to drive, one of those vehicles has to have connectivity. The vehicle networks are therefore thought of as the absolute most important element of transport system development along with intelligent cities. Social Systems are expected to produce a range of luxury application that varies from road safety to efficiency, even from computerized access to Web products and solutions. The world of automated vehicles is becoming popular, including a recent revolution in the automotive industry. Impediments are present, such as health, trust and loneliness when fully automatic models are used. The simple fact of the fact that automatic vehicles tend to face several safety hazards cannot be missed. In a situation in which an attack can result in many accidents when the AV applications are still reflective. Often, the Web-associated application can be exploited with users with disabilities, but there are also several other hazards not identified. The vehicle is designed so that the safety-critical dilemmas are anticipated and that it can perform roles when monitoring the requirements on the road during the entire journey. Such a design presumes that the engine driver will deliver the navigation or destination, although it probably will not become a holiday destination. The function of the automatic osmosis methods could, therefore, be covered, sound efficiency. Although the technique of automated osmosis is very different from the technological innovation of your associated vehicle, it's associated with it. The connected networked systems allow vehicles to share information [17], [18]. In addition, vehicles can exchange detector data with all surrounding vehicles, which can actually produce an AV with additional information on the decision. Pros from your global debate, such as the Insider and Earth, the Economic Forum foresees the effect of automatic vehicles on the general economic route and the shift of the relocation to 1 position. After that this paper could see your automatic vehicles, such as Uber or even Ola, switching over.

**Difficulties**



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

The proximity and decentralization of the ceremonial infrastructure at the edge offer different gains for networks, such as latency and the efficient use of power and increased output. The latest vehicles have been integrated with different processing detectors and wireless communication capabilities. That has allowed many future benefits, such as basic protection, efficiency, and relaxation, to be manipulated as they are on the street. Various barriers.

**Portability**

Types of detector networks take into account a static atmosphere. In addition, marketing hoc culture is targeted at minimal liberty focused on notebooks and consumer handheld devices. Indeed, freedom is only a standard in-vehicle network. Freedom is important for the routines of those vehicles. Each vehicle in the trail has a constantly changing pair of neighbors and a number that it has never seen before and can be unlikely to have a potential connection. This changing dynamic temperament may impair the utility of reputational strategies. It is more debatable to determine invaluably whether various vehicles based on the efficiency of the reports are to speed up; any specific vehicle will probably not be adequately advised to generate the choice of this engine. In addition, because two vehicles are inclined to be communicated a few seconds, protocols that require interplay between recipient and sender cannot be believed. An improved mobility version is needed to give information on accurate climatic behaviour, such as vehicle speed, vehicle standing forecast and space and time and space distributions. This paper need to create an even fancier version of liberty, which examines both the routines of freedom in detail and for different environments and can be used for practical applications. The knowledge of common vehicle habits and patterns of freedom allows us to use and convey the source of information. The freedom between edge nodes and cloud and between edge nodes can be examined. Unlike data centres, advantage apparatuses over and above platforms are deployed. The QoS must also be optimized in all programs.

**Forwarding and Routing**

In routing and adware, several questions arise in line with these movements of the vehicle as the moving of the gain servers and their resources from source to venue. Edge machine change: motor vehicles normally produce findings from this second movement over a short period whereas the vehicles are constantly moving at a predetermined pace. This makes it difficult to predict that the vehicle needs solutions, depending on visitors and on the general transport information that translates automotive immigration routines to the second position, for those beds to have bottom channels or advantage servers. Despite several methods to resolve the problem, it can be nonetheless an open question of research and far-reaching work needs to be done. Service changes. The previously discussed motor vehicles will be transferred to a different edge server if their location is switched to a 1 edge system, then the job for which they had complete responsibility against their previous edge server. An algorithm was suggested in to predict the QoS for support advice. While this algorithm is cost-effective for your client, it may not be very efficient in a windy environment. This can be a challenging and sensitive job in order to obtain timely and effective transmission of



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

assistance between vehicles and advantage servers so that the QoS is held in windy surroundings.

**Arrangement of Network Elements**

A decent number of elements of the system enhance large-scale operation. Since this system equipment is mounted at a higher price point, it is important to install a sufficient variety of such systems products vehicle. The most important thing is to always find the right place to improve the efficiency of social systems. In addition to the fee, the edge servers must be optimized and SRSUs must also be set up effectively at such points where the tools that are available may indeed be used. Since there are several visitors in the surroundings, servers have been located. As servers play a crucial role in delivering target visitors jams, the existing SRSUs adjacent to the servers lead to jams for visitors without multi-shop communications. All such programs are moved throughout the infrastructure with additional nodes from the system. By getting fewer jumps, the infrastructure exceptionally cuts the time of servers that send messages to one more node. That's why the best version is eventually required which works in addition to SRSU, to minimize the installation cost and optimize the QoS by using minimal advantage servers.

**Security and Privacy**

The complexity and flexibility of those networks and also their non-stiffness raise questions about the safety and solitude of data with all the primary barrier functions as the security of authentication. At the end of the vehicle, nodes function as entry points into hybrid clouds, which include edge nodes and the main cloud, so that stability and solitude are in danger. Although some of these edge nodes were used, a hacker could send banned orders and prohibited messages. This could cause all the companies that the system offers to be unreliable. Together with user loneliness, this system's current instance also poses an increased risk, while hackers are also able to access their customer's individual facts. From the wise grid elements, the crucial business and key people have enhanced their authentication problems by increasing their system systems. In the same way, syllable et al analysed multi-authoritarian CP-ABE multi-publication strategy which is best decrypted, to achieve data access control in a social system. But many security issues continue to rise, likely due to this high rhythm of edge systems expansion. More lively systems must be shown that information is encrypted in order to avoid infringement of stability and loneliness, and the benefits calculated are also safer.

## II. CONCLUSION

The expansion IoT requires new processing paradigms and the collection of information. In order to manage the data, fog computing emerged. The combination of cloud and fog calculation systems is a more complete way of providing the storage to promote a broad range of requirements and IoT, from low latency / real-time, to work or even application. In the context of geo-distribution, very little latency and location knowledge, new application designed because of your IoT growth requires assistance. In addition to how they could exactly expand and fit cloud natural surroundings, the paper discussed situations of fog and advantage computing and facets. The literature has fully



**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**

addressed aspects of the cloud and fog computers; others have yet to provide an structure for both storage and IoT data processing. When fog computing technology is progressing with IoT plus several of those obstacles, this paper all expect resource control problems and their own productivity to emerge as the number of devices and applications grows along with it.

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**Received: Sep 2019 | Revised: Oct 2019 | Accepted: Nov 2019**