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Analysis on Data Sharing methods in VANETs with Fog Computing

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Abstract
The Vehicular Ad-hoc Network (VANET) is the type network in which the centred controller is not available. Due to the high mobility in vehicle nodes and the decentralized nature of data sharing, routing are the major issues of VANET. The Fog Computing is the technology which is used for the data uploading over the fog. The fog computing technology is used for the data sharing in VANETs. The usage of Fog computing in Vehicular Ad hoc networks is increasing steadily. In this paper we reviewed the basic concepts of fog computing.
Keywords : VANETs, Fog Computing, Cloud Computing.

Introduction

The VANET is the type of the network which is come under the MANET. As in the Vehicular Ad hoc network, vehicles are moving and their position is changing as they are mobile in nature. All vehicles in VANET are deployed with road-side units, sensors with are giving the exact information about the vehicles [1]. With the formation of low span infrastructure-less networks which are wireless in nature is enabled by the road-side units. Both vehicle-to-vehicle and vehicle-to-roadside transmission is provided by VANET. Each vehicle within the network acts as transmitter, receptor or the protocols to transmit information to the moving vehicles [2]. Afterward, this data is used by roadside units for ensuring safety and free traffic flow. Intelligent Transportation Systems (ITS) are designed and developed using VANETS. These systems improve safety and transportation. In recent times, VANETs are being employed in various applications. These applications include monitoring the traffic, accidental situations, road traffic safety, commercial offices, detection of crisis locations, automatic tax paid machines and so on [3]. Initially, VANETs used cloud computing services to perform various tasks such as transmission, calculations and store services. The fog computing uses a centred fog server and distant server to provide calculation and storage services. Clients having the networks which are virtual in nature, virtual servers for distant store location or calculation services are provided by cloud computing [4]. It is possible to get the access of data stored in any location outwardly the issue to maintaining huge saving area or computing nodes in the vehicles. Among the vehicles, clients could exchange and allocate massive volume of data [5]. Discontinuation of transmission in information and data to the moving node from distant fog data-server or reverse to the moving nodes afterwards storing or transmitting be the big concern of cloud computing. Due to the great increase of the amount in linked moving nodes or in this large increase in the mobility, need for the services which provide small delay, continuous data sharing has increasing gradually. A continuing rise for the need of services which maintain minimum delay and nonstop applications can be seen with massive growth of amount in linked moving nodes or their constantly rising movability [6]. Due to emergence of modern and advanced vehicular applications has made it complex to deal with the challenges of competent communication and calculation. Vehicular Cloud Computing (VCC) services face another big challenge related to the QoS (Quality of Service). This challenge amalgamates fog enabled computing with VANETs [7].

Strong communication and computational support will be required by several vehicular applications designed for modern speedy vehicles. Fourth-generation mobile network and On-Board units are some

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other solutions that offer communication and computational support aside from cloud computing. But, these technologies have a lot of limitations. Service providers control their particular cellular networks. In VANETs, this limits communication adaptability [8]. Deploying Road Side Units at a bigger scale is a difficult task. This is a costly process and also has some limits. Fog computing is an archetype. This archetype expands in applications of computing services in the Network. An intermediary fogged layer has been provided by fog computing among the edge or cellular gadgets [9]. The deployment of devices in the fog-enabled layer with storage or communication potentials is performed near to the devices of clients. Applications provide improved QoS with fog computing due to the offering of computing and storage services on the edge or extremely close to the user. In vehicular networks, Vehicular Fog Computing provides support in the strong communication [10].This approach also provides computational assistance to the modern applications. Fog-enabled VANET is an extremely realistic objective [11]. Fog-enabled VANET offers computation, or network applications among smart devices and cloud servers. In general, these are not absolutely organized at the network's edge. In such a situation, outwardly need of the another application, large number of diversed and transmitted to fog devices interacts or collaborate to one-another for the storage of the data and perform computing tasks. Crucial network functions, novel applications running in virtual networks have been supported by these tasks. There are some significant features included in fog computing [12].

It is possible to predict the demand of services as per the location of mobile users. To demonstrate, a cellular user in the local market mall shows interest in local cafés, sales etc. Fog computing arranges fog devices in the shopping mall to provide high-rate local services and thus provides a solution of this issue. Among the fundamental networks and the servers, the number of Fog-enabled servers is installed by Fog Computing [13]. These services related to calculations, transmission or storing has providing in the vicinity of user edge devices in vehicles. Amid of moving nodes or the fog Server, the deployment of a fog server layer is performed.

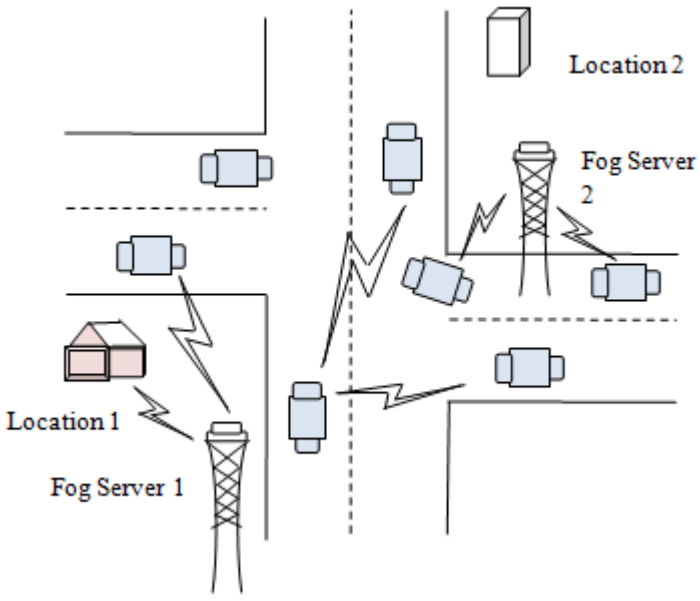

Figure 1: Fog computing in VANETs

Fog computing aims to widely distributed deployed applications with the comparison to the cloud computing services [14]. In vehicles, data are gathered by the sensing devices. This processing or storing of the gathered information were done in intermediary cloud servers [15]. With this the small-latent

transmission or more perspective knowledge have been provided by facilities. At the fog servers, the processing of large number of data from the vehicles is done. The instant reaction is offered by moving nodes. This fog server communicates with edge device as per requirement. It is very advantageous to use fog computing for small-delay in services. These applications include 3D animation and games. Fog-Computing can assist applications based on the needs of low latency because of the benefits of edge location [16]. Smart lights behave as fog devices. These devices are synchronized to propel warning signals to the moving vehicles. In order to improve communication among moving nodes and origin, Wimax, 3G, on-board units and STL(smart traffic lights) play an important role [17]. An extremely distributed collection of the traffic information occurs on extensive geological units data. This ensures that a satisfactory level of evenness among the different aggregator points is important for implementing effective traffic rules. In fact, the speedy growth in the number of vehicles creates a mess in traffic. A vacant location is identified using fog computing and roadside cloud. It is possible to share any parking space at various locations using this system.

Literature Review

Ahmed Jawad Kadhi, (2019) proposed a novel multicast routed path for VANETs. This proposed work was built on SDN and Fog-Computing. Their main aim was minimize of use of energy [18]. Some issues related to bandwidth and deadlines were considered by the proposed protocol. There were four layers included in the recommended design. These layers were called moving nodes.. In this work, a prioritized depend on scheduled and a classified algorithm were proposed for scheduling of multiple requests on the basis of service approach and dead-line issue later their classification. The achieved simulation results revealed that that EEMSFV algorithm showed superior performance over MABC and CVLMS in terms of different performance parameters.

Jorge Pereir, et.al (2019) proposed a generic design to deploy Fog Computing applications and facilities in a VANET system. In addition, in a hybrid VANET/Fog environs, a proof-of-concept scheme was provided for performing data analytics [19]. There were two Fog applications that used this system. The first application used this system to detect city traffic irregularity while the other application estimated the arrival of bus time to provide information to travelers using this system. A recently implemented big vehicular testbed was used to verify the trustworthiness of these applications by factual mobility information. The obtained results depicted that the use of fog computing of minimum amount of current geographical information was extremely appropriate in such services.

Jéferson Nobrea, et.al (2018) presented a research work on the designed principle using Fog-Enabled vehicular Software Defined Networking (VSDN). The main aim of this work was to pay attention to the viewpoints of the systems, networking, and facilities [20]. In order to evaluate these design principals, these design principles were utilized in real time traffic management system. This phenomenon used real traffic accident data to provide speedy rescue from traffic accident. At last, a discussion was made on possible research issues and opportunities to use fog-enabled VSDN in integrated manner.

Hasan Ali Khattak, et.al (2019) presented VANET design based on fog-computing. The proposed design was provided with an infomercial application set-up [21]. From the results, store dimensions of the vehicles was utilized a framework in performed tests. This was done for evaluating its effect on various performance parameters in the fog-enabled VANET system. It was concluded that this work presented several advantages of a fog based VANET along with considering future issues and their possible way outs.

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Xincao Xu, et.al (2018) presented an analysis of security related applications in VANETs. In particular, a new design based on vehicular fog computing was proposed in this work. In this design, different communication interfaces established communication of vehicles between the cloud severs and the fog servers [22]. This work, a competent collision prediction algorithm was proposed as well. The main motive of this algorithm was to improve safety during driving. The system had been implemented and field tests were performed in real time vehicular communication scenarios. These tests depicted the supremacy of fog computing based CW system. This system provided support to low latency and safety related services in VANETs.

Joseph Khoury, et.al (2019) studied and analyzed the utilization of the Software defined wireless network in VANETs.For this purpose, the supposed high delay between the SDWN controllers was considered [23]. These controllers were deployed based on the fog servers and the wireless networks. The more congestion approaching to the manager, more velocity of vehicle or Road-side units range were also considered in this work. This work used Mininet-Wifi for implementing the design of a vehicle enabled fog computing or suggested various developments. This achieved results depicted that utilization of the SDWN with Vehicular Ad hoc Networks framework didn't give satisfactory in most of the situations.

Seyed Ahmad Soleymani, et.al (2017) propose a reliable working model built with Fuzzy methods in VANETs with Fog Computing. This proposed trust model implemented a sequence of security checks [24]. This was done to make sure the accuracy with data obtained by approved moving nodes. This analytic results revealed the proposed results along with the detection of malevolent intruders and defective nodes also removed the doubt and vagueness information from VANETs.

Kang Kai, et.al (2016) presented the existing research work and future perceptions of VANET based fog computing. In addition, a discussion was made on advantages of fog-enabled services [25]. These features and services were based on VANET dependent fog computing platform. Some opportunities for challenges and concerns were described in this work. Some relevant methodologies were also discuss on the perspective of Fog-Computing in Vehicular Ad hoc networks. At last, a discussion was made on research directions of possible further work for VANETs based Fog-Computing. This research work provided more knowledge to the readers about VANET based fog computing.

Table 1: Table of Comparison

Author name	Year	Description	Outcomes
Ahmed Jawad Kadhi, Seyed Amin Hosseini Seno	2019	Proposed a novel multicast routed protocol for the VANETS. The proposed work were on the SDN and fog computing	The achieved simulation results revealed that that EEMSFV algorithm showed superior performance over MABC and CVLMS in terms of different performance parameters
Jorge Pereir, Leandro Ricard, Miguel Luís, Carlos Senna, Susana Sargento	2019	Proposed a generic design to deploy the applications of the Fog Computing and facilities in a Vehicular ad hoc network system.	The obtained results depicted that the use of Fog Computing with a small set of current regional data was extremely appropriate for such applications
Jéferson Nobrea, Allan M. de Souzab, Denis Rosário, Cristiano Bothd, Leandro A.	2018	Presented a research work on the design principles for fog-enabled Vehicular Software Defined Networking (VSDN).	A discussion was made on possible research issues and opportunities to use fog-enabled VSDN in integrated manner.

Villas, Eduardo Cerqueira, Torsten Braune, Mario Gerla			
Hasan Ali Khattak, Saif Ul Islam, Ikram Ud Din, Mohsen Guizani	2019	Presented VANET design based on fog-computing. The proposed design was provided with an infomercial application set-up	It was concluded that this work presented several advantages of a fog based VANET along with considering future issues and their possible way outs.
Xincao Xu, Kai Liu, Ke Xiao, Hualing Ren, Liang Feng, Chao Chen	2018	Presented an analysis of security related applications in VANETs. In particular, a new design based on vehicular fog computing was proposed in this work	These tests depicted the supremacy of fog computing based CW system. This system provided support to low latency and safety related services in VANETs.
Joseph Khoury, Hani Sami, Haidar Safa, Wassim El-Hajj	2019	Studied and analyzed the utilization of Software defined wireless networks in vehicular fog computing system. For this purpose, the supposed high delay between the SDWN controllers was considered	The achieved results depicted that used of Software defined wireless Networks in a Vehicular ad hoc networks framework didn't give satisfactory in most of the situations.
Seyed Ahmad Soleymani, Abdul Hanan Abdullah, Mahdi Zareei, Mohammad Hossein Anisi, Cesar Vargas-Rosales, Muhammad Khurram Khan, Shidrokh Goudarzi	2017	Proposed a reliable method based on the Fuzzy methods in Vehicular Ad- Hoc Networks with Fog Computing. The proposed reliable model implemented a sequence of security issues.	In this, analytic results revealed that the proposed solution along with the detection of malevolent intruders and defective nodes also removed the doubt and vagueness of data from vehicular networks in both line of sight and non-line of sight scenarios
Kang Kai, Wang Cong, Luo Tao, "Fog computing for vehicular Ad-hoc networks: paradigms, scenarios, and issues	2016	Presented of existing research work and future perceptions of VANET based fog computing.	A discussion was made on pathway of the possible outlook work for VANETs based fog enabled computing. The research work provided more knowledge to the readers about VANET based fog computing.

Fog Computing advantages and disadvantages:-

Advantages:-

- While using Fog computing it can help to increase the reliability of the data.
- To deploying the architecture model it can takes less cost.
- This can also decrease the latency.
- It also takes the decisions as fast as possible as per the requirements.
- It can reduce the impact of loss of data.
- It can take less time for transmission of the data to the nodes.

Disadvantages:-

- Due to the large data transmission, sometimes there are the chances of that speed is decreased.
- Security is the biggest issue in this, during transmission sometimes unknown attacks can occurred that can harm the data.
- While the nodes are moving and it take more power.
- In this data integrity is decreased.
- Delay in the transmission is the bigger issue in fog computing.

Fog Computing applications and Security issues:-

Applications:-

- Fog Computing is used in the health caring service centres.
- It is used in the areas of calamity where urgent need is required.
- Major application of fog computing is it used to analyse the traffic congestion on roads.
- It can used to control the system of the traffic on the roads.

Security Issues:-

- Authentication is the major issue in the fog computing.
- Another issue is it does not provide scalability to the nodes.
- The trust model is not established in fog computing due to attacks on moving nodes.

Fog Computing Challenges:-

- The major challenge is to protect the data over the network.
- To provide the peer-to-peer authentication for the fog enabled nodes.
- To give the privacy to the private data can be sent over the network.
- To provide the access control over the data.

How the demand of VANETs increasing:-

As with the increase in the demand of the infrastructure-less network, Ad-hoc network in today's scenario plays an essential role. In which the nodes can communicate with each other with the help of the ad hoc network. VANETs in which it is Vehicular Ad hoc Network in which they does not depend on any fixed network connection.

The VANETs provide the information about the exact position of the vehicles. In many applications and services the VANETs are used like to control the congestion in the traffic on the roads, to know about the condition of the roads, to check the accidental situations etc.

VANETs is using everywhere all over the world. With the help of this it can save time moreover it can reduce the chances of the congestion. Security is very important in VANETs which can decrease the effect of the unknown attacks in which the data cannot be lost while transmission of data from the transmitter node to the receptor node.

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As shown in the figure 2, the demand of Vehicular Ad hoc network is increased as increase in the year. As it can be analysed that, In 2008 the demand of the VANETs was only 20%, In 2010 it is shown that demand was 40%, In 2012 it was 60%, In 2014 it was 80%, In 2016 it was 90%, and In 2018 the demand was increased upto 95%.

It can be analysed that with the ever increase in the demand of the VANETs is increasing rapidly. In future the demand will increase more than this.

The following figure shows that how the demand of VANETs increasing :

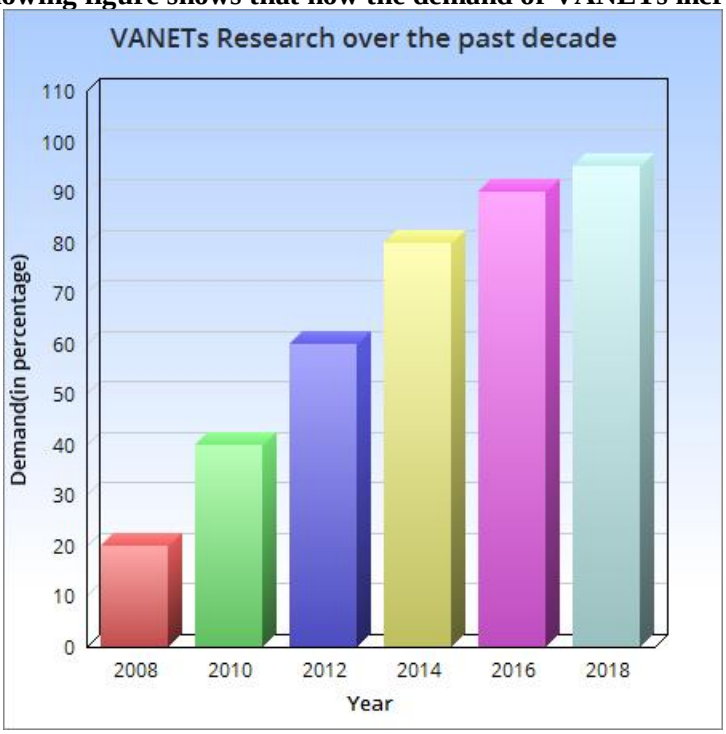

Figure 2:-VANETs demand over the past decade

Conclusion

In this paper, various basic concepts are reviewed for the fog computing in vehicular ad hoc Network. The vehicle enabled network has very dynamic nature because more movability of the vehicular nodes. The various type of location addict routing protocols are used for the direction formation from the first node to the last node. The fog computing is the technology which is used with the vehicular ad-hoc network for the data sharing.

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