Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 2, February 2015, pg.236 – 246

RESEARCH ARTICLE

An Ontology-Based Approach for Migration Service in Vehicular Cloud Computing

1st Malihe Mohadesipour, 2nd Shahram Mazloom, 3rd Hamideh Babaei

[1] Mahallat & Islamic Azad University, Iran

[2] Mahallat & Islamic Azad University, Iran

[3] Naraq & Islamic Azad University, Iran

[1] malihe_mohadesi@yahoo.com; [2] emshahram@yahoo.com; [3] hamidehbabaei@yahoo.com

Abstract— Cloud Computing, Moving Vehicles, wireless telecommunication infrastructure, portable computing device and to location and web based services are currently established for vehicles cloud computing. In this paper, we suggest a method for migrating services in case of traffic vehicles or congestion moving vehicles while service Quality of Services (QoS) needed is reduced. This method measure Quality of Services continuously and detects its challenges and then suggests service provider with optimum quality of service for migrating services. In general, if the provider of services fails to deliver the desired Quality, we will be forced to migrate to another provider for continue working. The result obtained from simulation of this method indicate that despite increased moving vehicles; this method can complete providing service more likely guarantee by migrating from one provider to another than when the services migration is not available.

Keywords— cloud computing, vehicles network, mobile cloud computing, vehicles cloud computing, services migration

I. INTRODUCTION

Increasing requests and needs to computing demand computing systems to perform their duties with more power and flexibility than previously. cloud computing (CC) provides a simple availability based on the operator request through connectivity a network to a series of changeable computing sources with less need to sources management and or need to direct intervention of a provider a service(e.g. [1]).

Vehicle cloud computing (VCC) is a new technology made of the combination of two general and most important issues of CC and vehicular ad-hoc network (VANET). in fact, vehicular CC refers to a group of autonomous vehicle whose united computing, sensor, communication and physical facilities are assigned dynamically and coordination to authorized users(e.g. [2]).

Vehicular cloud (VC) are also a new technology made of VANET wireless network. They are referred to as “Mobile clouds” which include CC advantages to help drivers in VANET than pay-per-use model(e.g. [3]). their communication type is V2V. when there are large number of vehicles on the streets, roads and highways with unused facilities there in, these facilities ,which are easily lost, can be used through CC model(e.g. [4]).

This technology can provide numerous computing services for drivers with low costs. In addition, by creating an integration among intelligent transportation system with computing capacities and saving huge Mobile Cloud Computing (MCC), provides better road security, intelligent systems, and urban traffic security(e.g. [5]).

Currently, one of the techniques needed to increase flexibility, scalability of cloud datacenter, and the best result of as model in CC is migration. Migration follows different purposes including load balancing tolerance of failure, energy management, response time reduction, increased service quality, repair and maintenance of servers(e.g. [6]).

© 2015, IJCSMC All Rights Reserved

Since service migration includes optimum use of sources on cloud and decreasing costs of cloud user ,by generalizing it to the new technique of VCC; it can be seen why services migration is necessary for providing numerous computing services with low costs to drivers which result in reduce in condensed traffic accidents, distance time, environmental pollution. it also result in maximum use of Quality of Service infrastructures(e.g. [2]).

Quality of Service(e.g. [7]) is considered most significant issues in CC and VANET networks. A major obstacle in CC is performance unpredictability because providers are unable to foresee temporal variations in service demands and the geographical distribution of their clients (e.g. [8]). There is a similarity between this problem and a patchy cloud in which it is not lonely capable to provide its computing sources needed. Therefore, for removing limitations the provided services in a large numbers of patchy cloud can be used for meeting vehicles needed. Numerous Quality of Services such as response time, scalability, performances, reusability and availability and ets are existed (e.g. [9]). such properties are a part of Service Level Agreements (SLAs) (e.g. [8]). This proposed method, firstly, the affecting parameters on the Quality of Service provider(or cloudlet); then measuring deliverable Quality of Services continuously to the vehicles and recording it in a catalog system is presented. if in any circumstances the QoS service is decreases, service migration should be performed to provide better services. In this stage , catalog system(e.g. [10]) by using queries based on ontology, which is in a form of an abstract layer on infrastructure layer, finds the best service and proposes it as a substitute. As a result, service migration is performed from a service provider to another.

Finally, the obtained results from service migration model based on measuring QoS continuously in this paper indicate that in order to increase the possibility degree of finishing the task and Reducing overload time and delay due to requests transition, we should migration them on time. But, There is no guarantee for finishing the task in non-migration method. Then it will be no necessary QoS and should be performed by another (new) service provider. Also, The proposed method help to automatically detect violations of SLA The intelligently.

The second section of the paper refer to previous work done in field of migration. In third section, a migration method in vehicular cloud computing and measuring its Quality of Service as well as mechanism of ontology-based catalog system and migration algorithms is provided. In the fourth section, we indicate simulation results and evaluate them. Finally, we indicate conclusions and future works.

II. BACKGROUND

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

A. Migration in CC

Migration in CC(e.g. [6]) is a process of moving a virtual machine(e.g. [11]) from a physical server to another without composing a interruption to a user. Therefore, time of moving storage, memory, processing status and network connecting as well as avoiding of service decreasing and waste of time should be reduced to a minimum degree. Type of migration are live migration and non-live migration and cool migration. There are techniques for each of these migrations in CC which are not discussed in this paper but could be studied in(e.g. [12]), (e.g. [13]), (e.g. [14]), (e.g. [15]).

B. Migration in VCC

It is considered the most significant issue in providing a highly service quality to the moving vehicles and an effort to secure driving in urban streets and reads. As shown in fig.1, VC can communicate with roadside cloud through access point. Roadsides cloud or cloudlets(e.g. [4]) as local sources respond vehicles requests through road side units(RSU). Therefore, the more suitable the QoS in cloud infrastructures or cloudlets, the more optimum of provided services to vehicles(e.g. [16]).

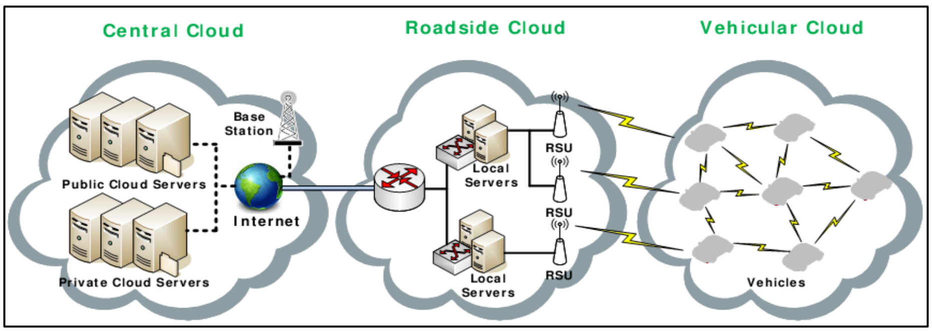

Fig.1 Classified vehicular cloud computing(e.g. [2,16]).

Since, there are likely no models for service migration in VCC regarding to V2I model, we focus in our paper on this model in order to increase Quality of Service in case of Moving and congestion of vehicles.

III. PROBLEM DESCRIPTION

RSUs are cloudlet interface and they deliver service to vehicle and vice versa. The service must have good QoS. QoS is conformable. We assume that Vehicles are movement and their speed is same. RSUs deliver services with lower QoS, because there are a few parameters that effect to QoS. Increasing distance between vehicle and RSU or number of requests on RSU reduce QoS more. To calculate the reduction, we designed a catalog system in central Cloud that uses queries based on ontology. Providers(Cloudlet) and their available Services, QoS, requests of vehicles and allocated services to vehicles are saved in the catalog system. We must calculate delivered QoS continuously because vehicles are moving and aforesaid parameters change continuously. In this case, if QoS violates SLA the service will migrated to another provider.

In this section, we present a method for service migration to the above-mentioned conditions and then, we present how to do it, rules, assumptions, metrics, assessment and results. To do this, we consider a V2I VANET that uses the IEEE802.11 in its MAC layer. In addition, we consider Cloudlets on the roadside with their RSUs that vehicles can connect to them. Services are simple cloudlets can provide all intended services. Also, roads side unites are overlapped.

A. Proposed Method

In this method, as shown in Fig.2, assuming that the vehicle is being gave service, constantly it sends its location coordinates to the catalog system of central Cloud. After the catalog system received the coordinates of vehicle, for all Cloudlets that provide the service and affected parameters on QoS, calculates deliverable QoS to the vehicle.

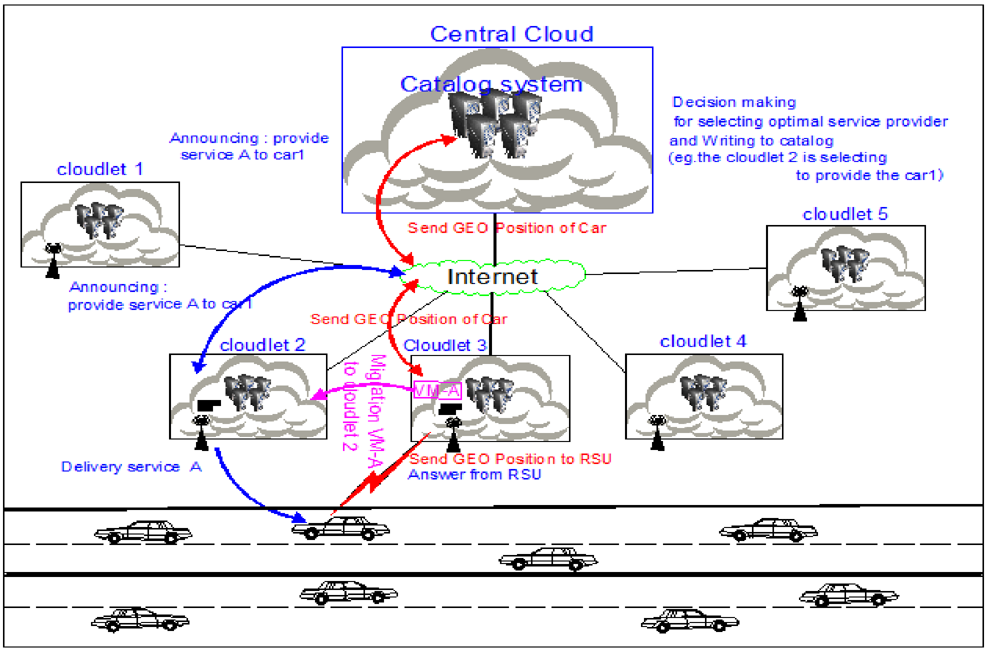

Fig.2 Steps of service provide to vehicles in the proposed method

It can be done in either case, conditional and unconditional. In first case, offered QoS is recalculated, if it be less than SLA then the above calculating will be done; in this case, there must be the following condition:

$QoS_{Offered} \geq QoS_{SLA}$

But in second case, always it will be done and allocated the best services to vehicles. In any case, there must be the following condition until migration is done:

$QoS_{Deliverable} \geq QoS_{SLA}$

In this method, after selecting optimum provider, it is recorded in catalog system and virtual machine migrates to it. Then, the selected Cloudlet gives service to vehicle wirelessly.

B. Measuring Quality of Service

Important parameters in this method are Quality of Service, geographical distance and number of clients for each Cloudlet. In this paper, we consider that QoS is Availability and two of the latter are impact parameters on QoS.

1) QoS: To measure the quality of simple and compound services, we have used from(e.g. [*8*]), but, we have not considered redundant service and any service is a single point of failure.

2) Geographical distance: Distance is a space between RSU to vehicle. Distance is a factor that decreases QoS. To illustrate effect of distance on QoS, we have used the Formula.1

Formula .1
$$distance_{GEO} = 4.R.tan^{-1}\left(\frac{\sqrt{sin^2\left(\frac{\Delta\varphi}{2}\right)+cos(\varphi_1).cos(\varphi_2).sin^2\left(\frac{\Delta\lambda}{2}\right)}}{1+\sqrt{1-sin^2\left(\frac{\Delta\varphi}{2}\right)+cos(\varphi_1).cos(\varphi_2).sin^2\left(\frac{\Delta\lambda}{2}\right)}}\right)$$

3) Number of clients: This parameter also decreases the QoS. To calculate effect of this parameter, first, the catalog system executes a query to achieve number of vehicles attached to RSU and then put it in the Formula. 2. In this formula, k is number of clients.

Formula.2
$$NumberofClient = e^k , k = 0, \ldots ,200$$

By integrating the formulas. 1.2, get Formula .3

Formula.3
$$QoS_{Delivered} = \frac{QoS_{initial}}{Distance*e^k}$$

C. Mechanism of Ontology Based Catalog System

According to Fig.3 All defined classes are subclass of owl:Thing super class. CloudletCapability is subclass of owl:Thing; RSUCapability and HostCapability are subclasses of CloudletCapability and SoftwareCapability, PlatformCapability and InfrastructureCapability are subclasses of HostCapability. Any subclass inherits properties of its parent. RSU, Cloudlet, Software, Platform and Infrastructure are instances of these classes.

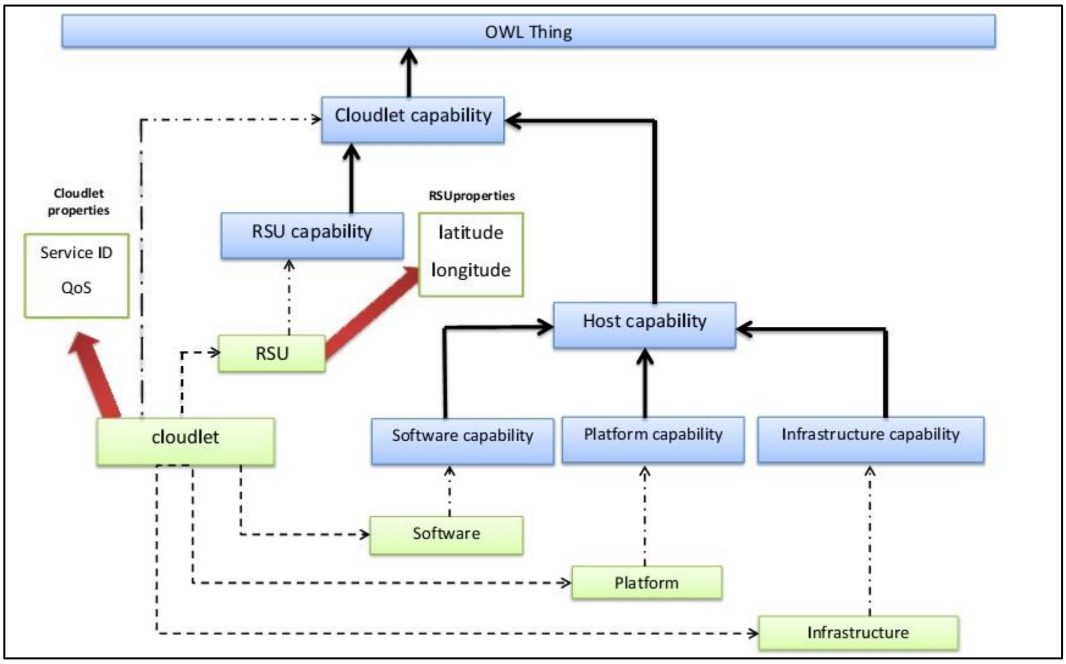

Fig.3 The proposed ontology with OWL

RSU is an instance of RSUCapability and has two properties, Latitude and Longitude that show geographical position of RSU. Cloudlet is instance of CloudletCapability and has two properties, ServiceID and QoS. The first characteristic is name of a service that Cloudlet provides and the latter indicates quality of the service.

D. Migration Algorithms

In the proposed method, we test algorithms in two states, conditional and unconditional migration. In the first algorithm, service migration is performed from present service provider to another when calculated QoS by catalog system is less than SLA; in the second algorithm, service migration is performed from one present service provider to another, even calculated QoS is not less than SLA.

1) Conditional Migration Algorithm: According to Fig.4, in this algorithm, catalog system measures QoS to deliver vehicles continuously. If deliverable QoS is more than SLA then service migration will not be done; and RSU (interface) will continue to

© 2015, IJCSMC All Rights Reserved

its work; but if deliverable QoS is less than SLA and there is at least one service provider with according QoS, service migration will be done and another service provider will give service to the vehicle. It means that the catalog system must choose another cloudlet with suitable QoS.

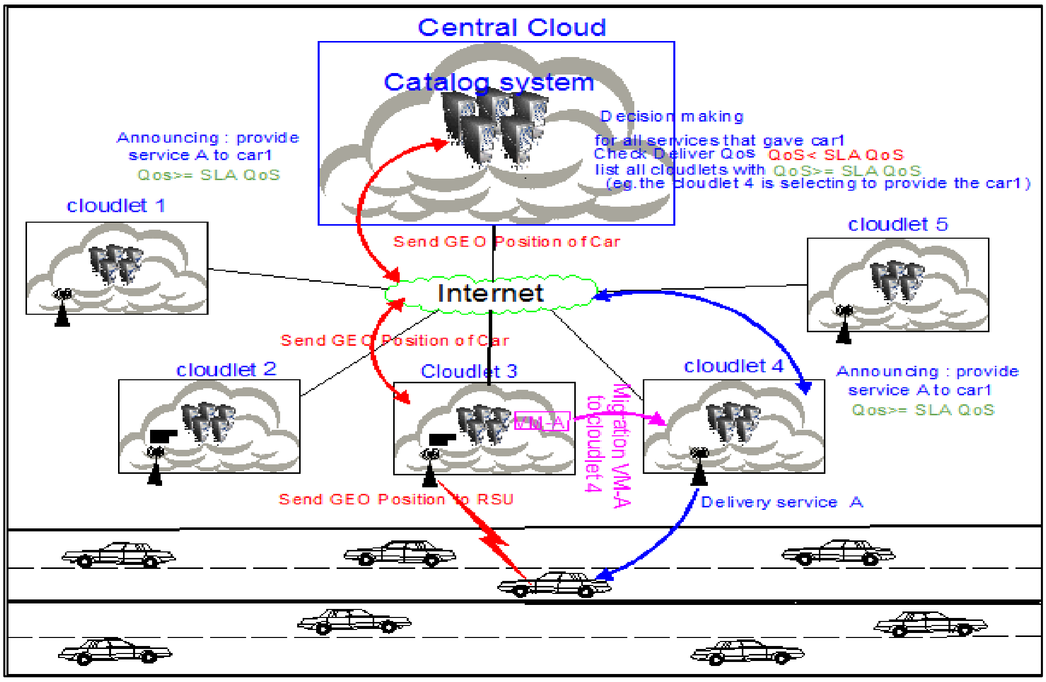

Fig.4 Step of services provide in conditional migration algorithm.

2) UN-Conditional migration algorithm : As shown in fig. 5, similar to the previous algorithm, catalog system measures deliverable Quality of Service(QoS) to vehicles continuously and service will be migrated by catalog system even calculated QoS is more than SLA and catalog system will choose another cloudlets with more suitable QoS.

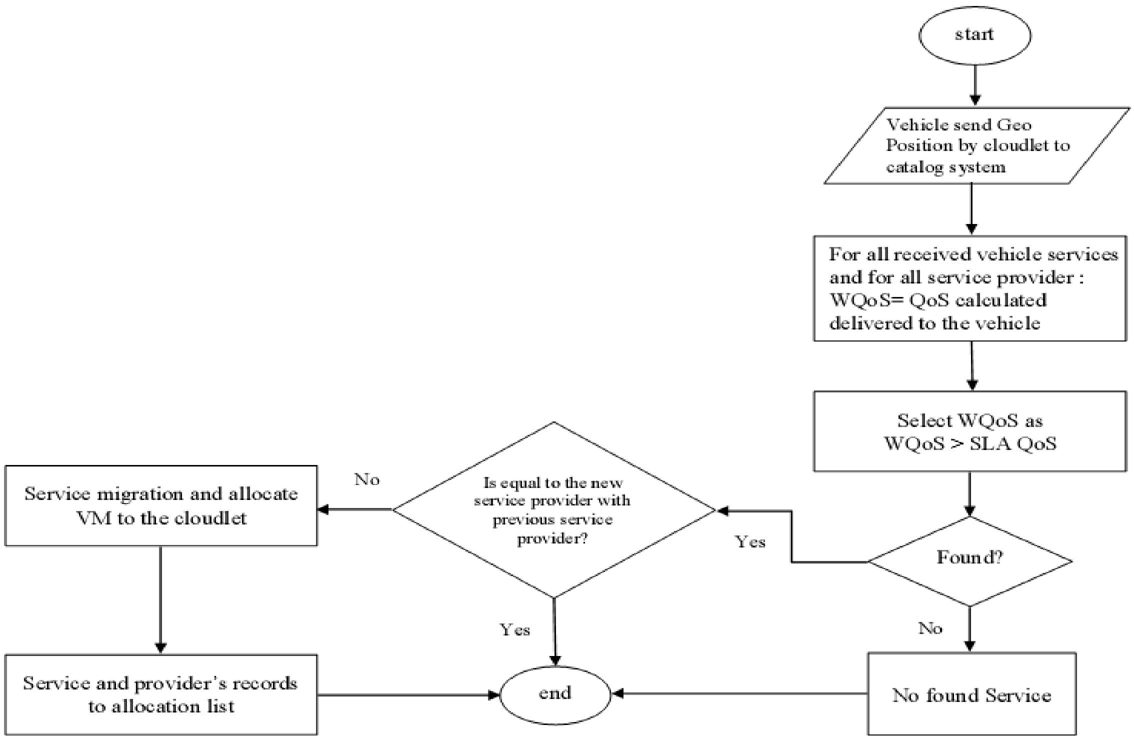

Fig. 5 Flowchat of the UN-Conditional migration algorithm.

Non-Migration algorithm is another method to give service to vehicles. According to Fig.6, we consider that the vehicle is getting service. If the service is discontinued in this time then QoS will be zero. In this way, migration is not performed and another provider with suitable QoS begins service from uppermost. In this method, catalog system knows the service is not completed nevertheless it selects another provider and the provider creates virtual machine. In this way, virtual machine is not migrated from cloudlet to another and previous performed work is overlooked.

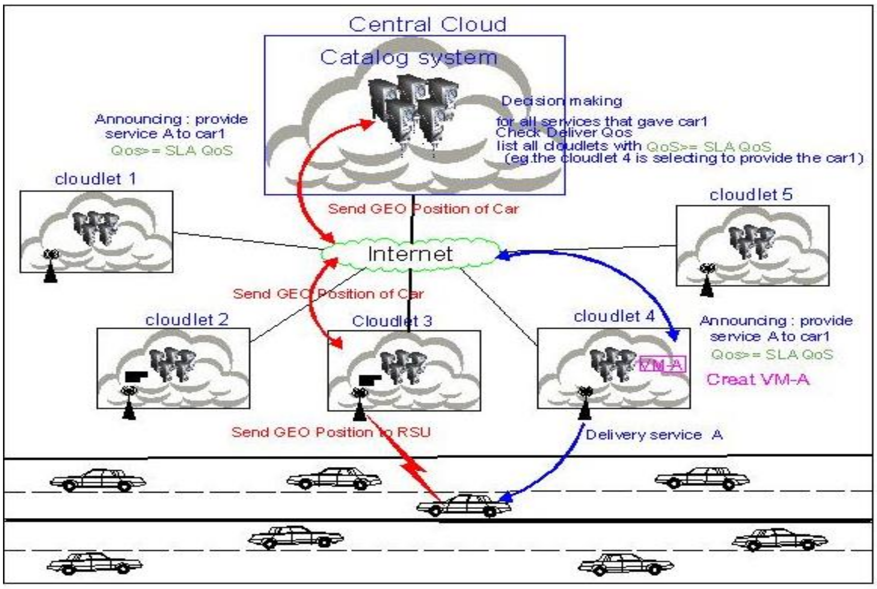

Fig.6 Step of Replacement service provider in non-migration state.

IV. Simulation and Performance Evaluation

In this paper we use SUMO Simulator to implement vehicular network. We assumed vehicles speed is constant and equal. RSUs have been arranged so that they overlap.

A. Simulation Components

The used components in the simulation include roads, vehicles, Cloudlets, RSUs, central Cloud and services.

B. Simulation scenarios

Road length is 100km; there are 50, 100, 150, and 200 vehicles; 10 Cloudlets and 10 RSU in roadside (e.g. Fig. 7).

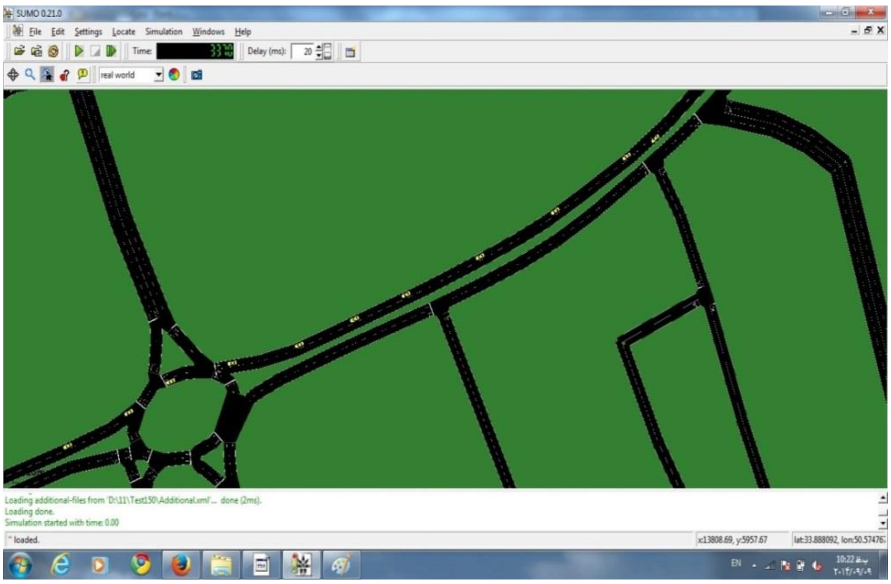

Fig.7 Vehicle movement on road.

C. Simulation metrics

We considered following metrics to analyze simulator output file and evaluate methods:

1) Average of Cloudlets workload: The Cloudlet workload is an important factor in determining QoS, thus we have calculated average Cloudlets workload in Formula.*4* . In the Formula, c is number of Cloudlet and n is number of vehicles.

Formula.4 $$Cloudlets\ Workload\ Average = \frac{\sum_{i=1}^{c}(RSU\ workload)_i}{n}, c = 10$$

2) Average of Cloudlets service time: We calculate average of servicing time for each service to vehicles and then calculate average them in Formula.*5*. In following Formula, t is the total of time measurement; s is the total of requested services and n is number of vehicles. To calculate the amount, time may not be continuously or tasks may not be completed.

Formula.5 $$\text{Service Time Average} = \frac{\sum_{i=1}^{n}\frac{\sum_{j=1}^{s_i}\frac{\text{Count}\left(t_{ij}\ [QoS_{ij}>0]\right)}{t_{ij}}}{s_i}}{n}$$

Therefore, Average of Service Violation means that We need to measure the times that there were request services but there were no Cloudlets to give service them. Formula6 indicates calculating method.

Formula.6 $$Service\ Violation\ Average = \frac{\sum_{i=1}^{n}\frac{\sum_{j=1}^{s_i}\frac{Count\left(t_{ij}\ [QoS_{ij}=0]\right)}{t_{ij}}}{s_i}}{n}$$

3) Average of provided QoS: we calculated quality of any service to any vehicle and then average quality of all services to any vehicle and finally, measured quality of all services to all vehicles. All of them are shown in Formula.7.

Formula.7 $$Service\ Time\ Average = \frac{\sum_{i=1}^{n}\frac{\sum_{j=1}^{s_i}\frac{\sum_{k=1}^{t}\text{QoS}_{ijk}}{t_{ij}}}{s_i}}{n}$$

4) Average of Cloudlet servicing: Its meaning is percent of task that have been performed successfully. For this purpose, we consider all time that a service is available.

5) Average of service migration: Because migration takes time thus, lower migration is equal to lower dawdling.

6) Cost of Vehicle: We calculate cost of each vehicle in all times that used services and then measure the average them. Formula. *8* indicates all them.

Formula.8 $$Average\ of\ Service\ Time = \frac{\sum_{i=1}^{n}\frac{\sum_{j=1}^{s_i}\frac{\sum_{k=1}^{t}\text{Price}_{ijk}}{t_{ij}}}{s_i}}{n}$$

D. Simulation Results

1) Average of Cloudlets workload Results: According to Fig.8 , it can be concluded that Amount usage RSUs have the most efficiency in Un-conditional migration.

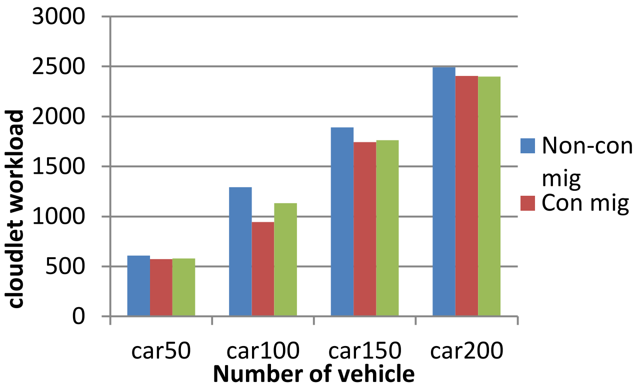

Fig.8 Average of Cloudlets Workload Results.

2) Average of Cloudlets service time Results: The Fig.9 shows that unconditional migration algorithm has the best average of service time. In the conditional migration algorithm, if the number of vehicles be increased the average of service time will be reduced that vehicles as service consumers will damage. But in unconditional migration and Non-migration algorithms by increasing number of vehicles, service time of Cloudlets is increased and amount of damage is reduced.

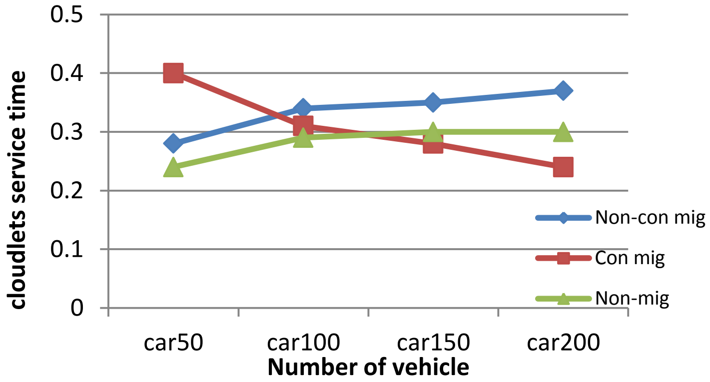

Fig.9 Average of Cloudlets service time Results.

The Fig.10 shows that damages to vehicles should be considered that the most amounts of damages are related to Non-migration.

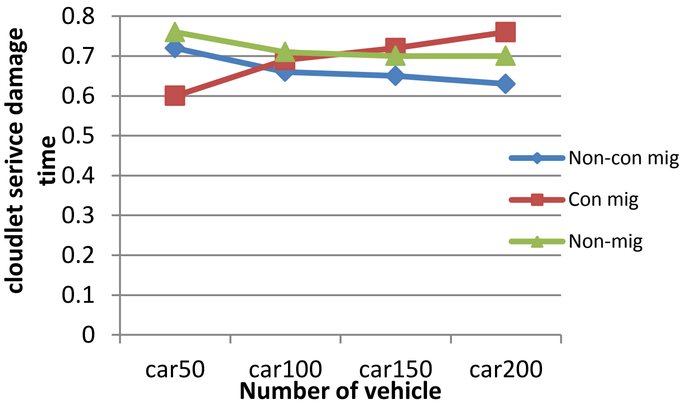

Fig.10 Average of Cloudlets service damage time Results.

3) Average of provided QoS Results: The Fig.11 shows that unconditional migration algorithm QoS is better than non-migration and non-migration QoS is better than conditional algorithm. In addition, QoS will be reduced by increasing the number of vehicles in all algorithms.

© 2015, IJCSMC All Rights Reserved

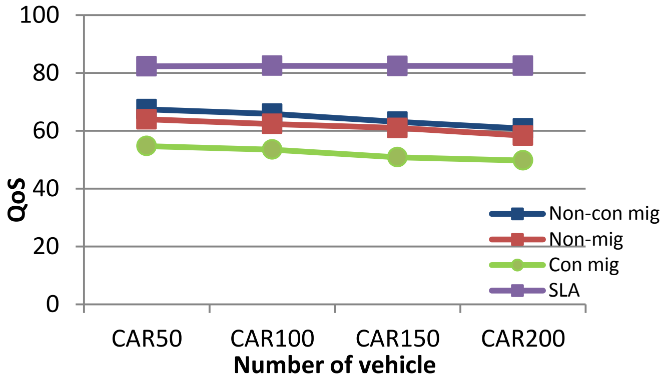

Fig.11 Average of provided QoS Results.

4) Average of Cloudlet Servicing Results: The Fig.12 shows that service rate of unconditional migration is greater than other algorithms; service rate of Cloudlets is increased by increasing the number of vehicles in conditional and unconditional algorithms while it is reduced in non-migration algorithm; in addition, less tasks are completed successfully in this algorithm; thus damages are increased.

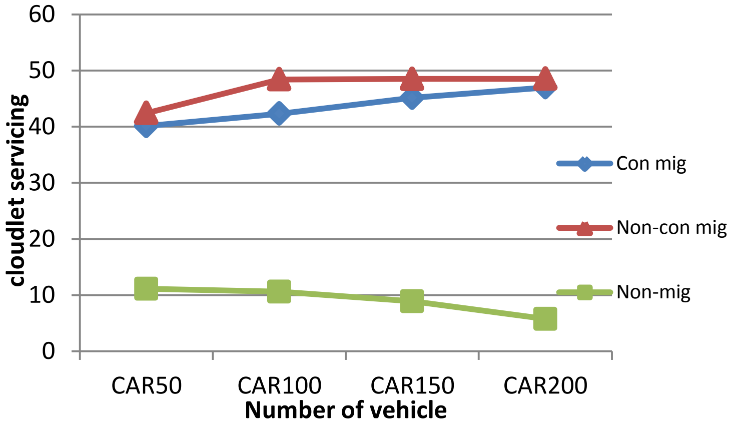

Fig.12 Average of Cloudlet Servicing Results.

5) Average of Service Migration Results: The Fig.13 shows that service migration in unconditional migration algorithm is more than conditional migration algorithm. Furthermore, it can be concluded that increasing the number of vehicles increased service migration. Whatever, dawdling will be increased by increasing service migration.

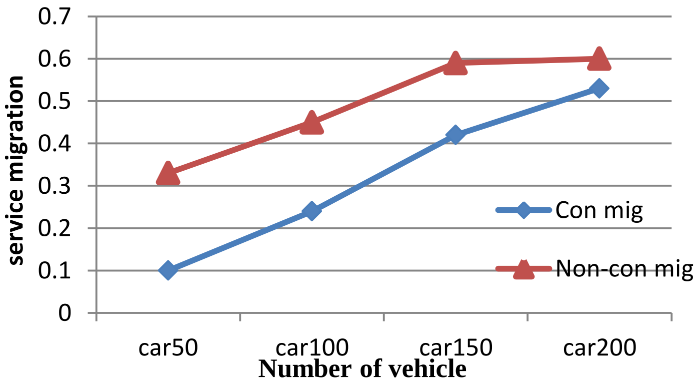

Fig.13 Average of service migration Results.

6) Cost of Vehicle Results: The Fig.14 shows that vehicles pay in unconditional migration algorithm more than other algorithms. So we can conclude that QoS and service rate is also more than other algorithms.

© 2015, IJCSMC All Rights Reserved

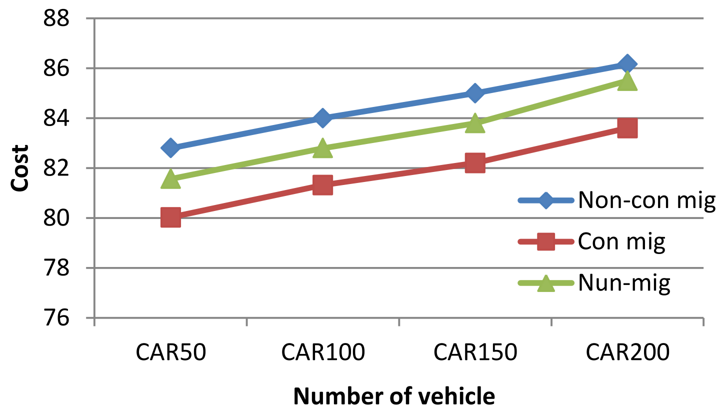

Fig.14 Cost of vehicle Results.

V. CONCLUSION

We proposed a method to measure deliverable QoS to vehicles. In this method, we evaluated QoS in two ways, service migration and non-migration. Then we evaluated conditional and unconditional service migration.

It seems that service rate is not increased by increasing workload on cloudlets. In unconditional migration, service rate is increased by increasing workload in Cloudlets. But it is not in non-migration, so that service and utilization rate is greatly reduced. Service rate is not also increased by increasing QoS. In the non-migration algorithm, although deliverable QoS is more than conditional migration; but its service rate is also much lower than conditional migration. Although, conditional migration algorithm has migration fewer and service time more than other algorithms; but it does not use from Cloudlets capacity maximally. Unconditional migration uses from capacity more than other algorithms and it provide optimum service rate and QoS; but in this algorithm, the number of migration is more than other algorithms that it imposes high overhead time to system; in addition, higher QoS is equal to more pay.

In total, we can say that if the number of vehicles is low, then conditional migration has the best efficiency and if there are too many vehicles, then unconditional migration will be better than other algorithms.

ACKNOWLEDGEMENT

We use from simple services that compound services can be used. Weight can be defined for the number of client and geographical distance. We considered constant speed for all vehicles that it can be considered differently. Threshold can be considered to in use services that prevents from lack of service before service violation.

REFERENCES

[1] Mell P, Grance T. (2009) Recommendations of the National Institute of Standards and Technology(NIST) . [Online]. Available: http://www.csrc.nist.gov/publications/nistpubs/800145/SP800145.pdf

[2] Whaiduzzaman M.d, Sookhak M, et.al. *A survey on vehicular cloud computing*, Journal of Network and Computer Applications, Elsevier,vol:1084-8045,pp:02-10.2013.

[3] Michael L.B, Nakagawa M. *Multi-hopping data considerations for inter-vehicle communication over multiple lanes*. Proceedings of IEEE Vehicular Technology Conference, Chicago. USA. pp:121-125.2008.

[4] Olariu S, Hristov T, Yan G. *The next paradigm shift: from vehicular networks to vehicular clouds*, by The Institute of Electrical and Electronics Engineers. Published2013by John Wiley & Sons.2013.

[5] Eltoweissy M, Olariu S, Younis M. *Towards autonomous vehicular clouds, Ad-hocnetworks*, Journal of ICST Transactions on Mobile Communications and Applications, vol:11, no. 1-16, pp1-11.2010.

[6] Clark C, Fraser K, Hand S, Hansen J, etal.. *Live migration of virtual machines[C]*. Proceedings of 2nd Symposium on Networked Systems Design and Implementation (NSDI'05), Boston, MA, USA, pp.273-286.2005.

[7] PireGrid , *QoS for cloud computing, CooprationTerritoriale*. University de Pau, France, May 1-23, PP: 53/08.2011.

[8] Bardhan SH, Milojicic D, *A mechanism to measure Quality-of-Service in a federated cloud environment*, Hewlett-Packard Enterprise Services, 4000 N Mingo Road -Tulsa, vol:918.625.1833.2012.

[9] Kumar R, Dave M. *Mobile Agent as an Approach to Improve QoS in Vehicular Ad-hocNetwork*, International Journal of Computer Advanced (IJCA) Special Issue on Mobile Ad-hocNetworks MANETs, PP:67-70.2010.

[10] Bernstein D, Vidovic N, Modi S. *A cloud PAAS for high scale, function and velocity mobile applications-with reference application as the Fully Connected Car*, in Proc. 5th International Conference on Systems and Networks Communications (ICSNC), pp. 117-123.2010.

© 2015, IJCSMC All Rights Reserved

[11] Yunfa Li, Wanqing Li, Congfeng J. *A Survey of virtual machine system: current technology and future trends*. IEEE 3th International Symposium on Electronic Commerce and Security. Hangzhou, China. PP: 332-336.2010.
[12] VenkateshaSh, Sadhu Sh, Kintali S. *Survey of virtual machine migration techniques*. Journal of Springer in Computer Science.2009.
[13] MohanA, ShineS. *Survey on live migration techniques*. International Journal of Advanced Research in Computer Engineering & Technology (IJARCET).Vol2, Issue 1, January. pp: 155-157.2013.
[14] Rakhik.R, Getzi P. *Live virtual machine migration techniques- A survey*. Proce International Journal of Engineering Research & Technology (IJERT), Karunya, Vol. 1 Issue 7, September.2012.
[15] Christopher C, Fraser K, Hand S, Hansen J. *Live migration of virtual machines*. Journal of IEEE Computer Society, share in University of cambridge computer laboratory. pp:10.1109.2005.
[16] Fernando N, Loke S.W, Rahayu W. *Mobile cloud computing: A survey*. Journal of Future Generation Computer Systems (FGCS) of Elsevier, vol:0167-739,PP:1-10.2012.

© 2015, IJCSMC All Rights Reserved