# Addressing Virtual Machine Migration Problems in Cloud Based Vehicular Networks

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## Abstract

With the development of IoT, Vehicular Ad-hoc Network will be shifted to Vehicular Ad-hoc Network managed cloud in near future. As the traditional cloud, VMM is a crucial problem in Cloud Based Vehicular Networks. Due to the distinct feature of high mobility, VMM Cloud Based Vehicular Networks need to be addressed to keep cloud services running on. When a vehicle moves on the road, it moves out one cloud and moves in another frequently. Therefore, the cloud service has to shift from one cloud site to another. All particular VMM scenarios are considered and analyzed in this study. Based on the full sketch, several important open issues and research challenges for VMM deployment and implementation are also presented.

Key word: VM migration, Vehicular cloud, Roadside Cloud, Cloud Based Vehicular Networks.

## 1. Introduction

At the present, it has witnessed a shift from traditional vehicular ad hoc networks (VANETS) to VANET Cloud network. At the beginning, the concept of Vehicular Clouds (VCs) has been firstly introduced in [1-5] by Professor Olariu and his co-workers. VCs has defined as a group of largely autonomous vehicles whose corporate computing, sensing, communication, and physical resources can be coordinated and dynamically allocated to authorized users. However, in VANET, the vehicles not only communicate together but also exchange information for Intelligent Transport Systems as roadside units (RSUs). Hence, in the initial VCs, additional infrastructure is needed for deployment since the infrastructure is already there. With this in mind, R. Hussain et al [6] has taken the vision of Alariu et al in order to thoroughly analyze VANET based cloud computing named VANET Cloud. Taking a step ahead, R. Yu et al in [7] have considered a cloud environment for vehicles by integrating redundant physical resources in ITS infrastructures, including data centers, roadside units, and vehicles. With this in mind, They have proposed Cloud Based Vehicular Networks, as shown in Fig. 1. There are three interacting parts in Cloud Based Vehicular Networks: The Vehicular Cloud, Roadside Cloud, and Central Cloud.

- *Vehicular Cloud*: A group of cooperative vehicles is connected with each other by using V2V communications.
- *Roadside Cloud*: A local cloud organized among a set of adjacent roadside units. The Roadside clouds allow the vehicles to access it by using V2R communications.
- *Central Cloud*: A cloud is established among a group of dedicated servers in the internet. A vehicle can use V2R or cellular communications to access Central Cloud.
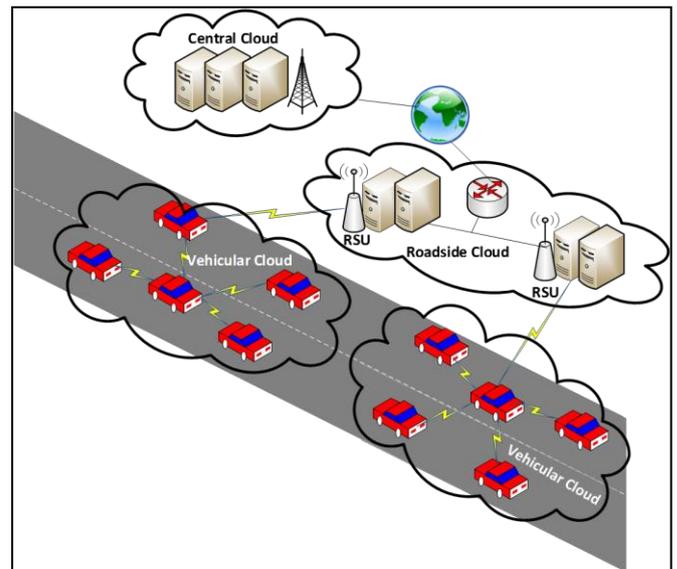


Fig.1. The Cloud Based Vehicular Network architecture.

As the traditional cloud, Virtual Machines migration (VMM) is a crucial problem. However, in Vehicular Cloud, the connected vehicles, the physical servers, move fast . Hence, the topology of Cloud Based Vehicular Network changes more rapidly in comparison to the conventional cloud data center. Moreover, physical hosts in Vehicular Cloud data center have limited computing and storage capacity when compared to a cloud data center. Therefore, solving VMM in Cloud Based Vehicular Network is fundamental challenges as discussed above.

The rest of this paper is organized as follows. Section 2 analyzes these Virtual Machine Migration Problems. several important open issues and research
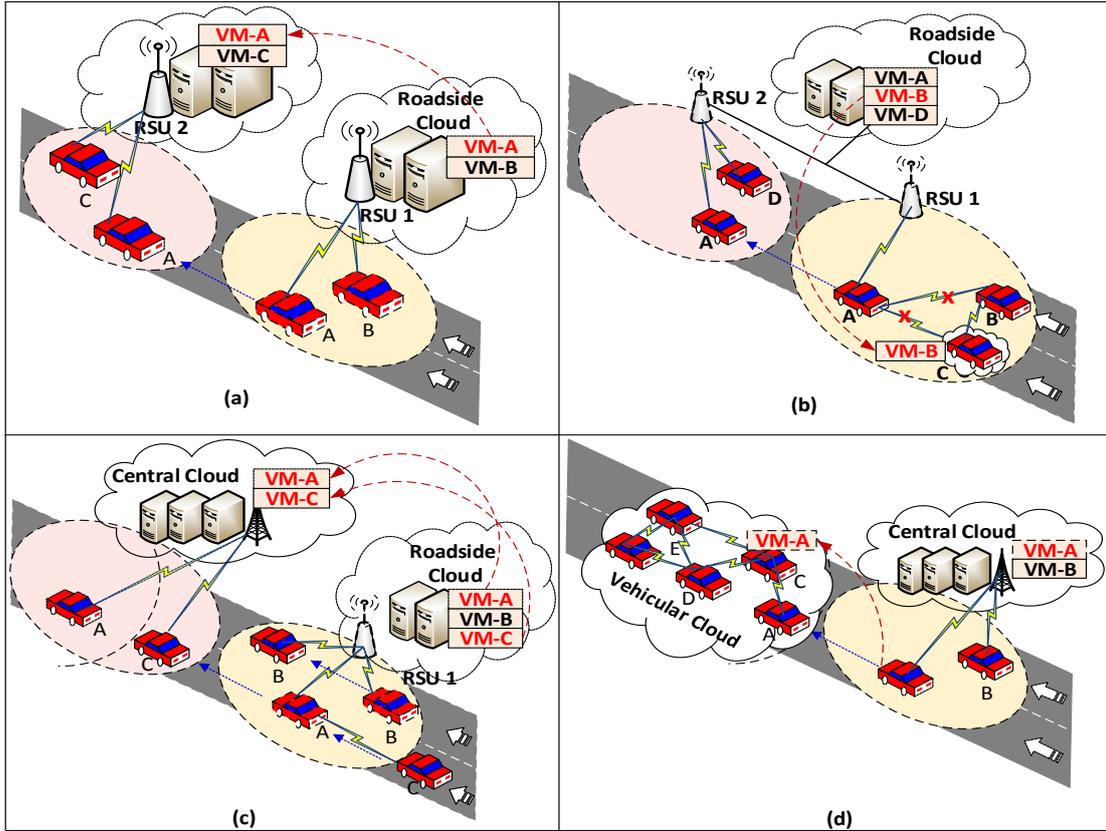
Fig. 2. Virtual machine migration scenarios: a) Inter-Roadside-Cloud; b) Across Roadside-Vehicular Cloud; c) Across Roadside-Central Cloud; d) Across Central Cloud-Vehicular Cloud

challenges for VMM deployment and implementation are presented in Section 3. Finally, Section 4 highlights the conclusion.

## 2. Virtual Machine Migration in Cloud Based Vehicular

Due to the vehicle mobility, when a vehicle moves on the road, it moves out one cloud and moves in another frequently. Therefore, the cloud service has to shift from one cloud site to another. As the traditional cloud data center, physical servers are firstly partitioned into multiple Virtual Machines (VM), and users are assigned VMM so that they can use the same physical environment by being totally isolated from each other [8].Then, VM is the task of moving a virtual machine from the source to the destination cloud site. As shown in Fig. 2, VMM in cloud-based vehicular networks has several different scenarios, as discussed in the following part.

○ **Inter-Roadside-Cloud Migration**

Fig. 2a illustrates the Inter-Roadside-Cloud migration situation. In this case, a VMM is required when i) a vehicle A moves from the coverage range of RSU 1 to that of RSU 2; ii) RSU 1 and RSU 2 connect to different cloudlets. In details, VM-A should be first transferred from Roadside Cloudlet-1 to Roadside Cloudlet-2. Second, A will access Cloudlet-2 via RSU

2 to resume its service.

○ **Across Roadside-Vehicular Cloud Migration**

Considering the scenario is depicted in Fig. 2b, initially, vehicles A, B, and C are connected in an ad-hoc manner. Vehicle C accesses the roadside cloud through vehicle A. As vehicle A moves from the radio range of RSU 1 to that of RSU2. This movement will cause the disconnection of C from the Roadside Cloud Before. In this case, across Roadside-Vehicular Cloud Migration occurs. VM-B will be transferred from the Roadside Cloud to the vehicle cloud in C. Then vehicle B can continue its service through D using V2V communications.

○ **Across Roadside-Central Cloud Migration**

The scenario in Fig. 2c is similar to that in Fig. 2b, except that there is no direct link between vehicles B and C. After A's movement, C also moves with the same direct, but C now is not in the coverage area of A. Fortunately, C is in the radio range of base stations in the Central Cloud. In this case, VM-C has to be migrated from the Roadside Cloud to the Central cloud. Besides, this scenario can happen in another situation. Consider vehicle A, when

n it moves out of the coverage range of RSU 1. There is no more Roadside Cloud, but Central Cloud exists. Hence, VM-A is necessarily transferred to Central Cloud. After that, vehicles A and C will resume its service using cellular wireless communications.

o    **Across Central Cloud-Vehicular Cloud**

In Fig. 2d, before A's movement, it connects to Central Cloud. However, The movement of A can give it an opportunity to transfer its VM to other vehicles. As shown in Fig. 2, vehicles A moves to the radio range of vehicle C. Then, A can resume its service by accessing to Vehicular Cloud using V2V communications.

## 3.   Open issues and research challenges

In Cloud Based Vehicular Networks, vehicles are considered as the resource consumers or resource providers. They can use several different cloud services from other vehicles, Roadside Infrastructures and ITS center servers. Because of the distinct feature of high mobility, addressing the problem of VMM Cloud Based Vehicular Networks is extremely crucial to keep cloud services running on. However, there are few studies on VMM in Vehicular Cloud environments [7-9]. Two essential questions should be raised for VMM.

i)    What VMM strategies should we apply?

ii)   What resource reservation schemes in VMM process do we need study to reduce service dropping?

These problems which are research challenges must be solved. Improving exist methods in mobile cloud environment is our suggestion at the present time ( e.g., cold migration, warm migration, live migration).

## 4.   Conclusion

With the development of IoT, Vehicular Ad-hoc Network will be shifted to Vehicular Ad-hoc Network managed cloud in near future. From this we put forward the VMM as a solution to efficiently utilize vehicles resources. A full sketch about VMM scenarios in Cloud Based Vehicular Networks is demonstrated. Those scenarios are particular situations which really need to be formulated and addressed in next time.

## 5.   Acknowledgement

## 6.   Reference

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