# Performance evaluation criteria:

Source: Tarek K. Refaat, Burak Kantarct, and Hussein T. Mouftah. *Dynamic Virtual Machine Migration in a Vehicular Cloud*

1. Average Percentage of Dropped VMs

2. Average fairness of the capacity utilization of the devices (workload)

Source: Tarek K.Refaata, BurakKantarcib, Hussein T.Mouftaha. *Virtual machine migration and management for vehicular clouds*

3. Average percentage utilization of the available upload band-width.

4. Average percentage utilization of the available download band-width

Source: Sherif Akoush, Ripduman Sohan, Andrew Rice, Andrew W. Moore and Andy Hopper .*Predicting the Performance of Virtual Machine Migration*

5. Total migration time may be defined as the sum of the time spent from initialization at the source host through to activation at the destination.

6. Total downtime is the duration in which theVM is suspended

* **Migration strategies:**

Source: Tarek K. Refaat, Burak Kantarct, and Hussein T. Mouftah. *Dynamic Virtual Machine Migration in a Vehicular Cloud*

This paper proposes a VMM framework for the vehicular cloud, named Vehicular Virtual Machine Migration (VVMM).

**VVMM-U**(Uniform) uniformly selects the new hosts of the VMs needing migration, due to a vehicle soon leaving the vehicular cloud.

**VVMM-LW** (Least workload) shifts the VMs to the device with the least workload. It initially searches for the devices nearby with sufficient excess capacity to host the source workload. If at least one device is found, the one with the least workload and nearest (i.e., search criteria) is selected out of the set. If the destination found will need to migrate the VM within T (maximum time possibly needed to perform a migration) seconds from now, the migration is resorted to RU(roadside unit in case of VANET).

The RU searches entire grid for vehicles with sufficient excess capacity to host the source workload. The RU uses the same search criteria, and aims at selecting the vehicle with the least workload and preferably the nearest one among those with the least workloads. If the VM is to be migrated within T seconds, the VM is temporarily hosted in the RU and migration is returned to be unsuccessful. Otherwise, the VM is shifted to its new destination successfully.

**VVMM-MA** (Mobility aware)- incorporates mobility awareness by shifting the VM to the vehicle with the least workload as well as one predicted to be within the geographic boundaries of the vehicular cloud, for the duration of the migration. VVMM-MA sets the search criteria as follows: Search for device nearby within r seconds guarantee. If the candidate is considered to be viable based on the mobility awareness, only then is it evaluated based on least workload, and finally proximity.

Source: Tarek K.Refaata, BurakKantarcib, Hussein T.Mouftaha. *Virtual machine migration and management for vehicular clouds*

**MDWLAM** -The device will select a destination with remaining time in the grid, greater than or equal to the summation of the time necessary for the source to migrate its load, and for the destination to migrate its load. The migrating device must further consider the time necessary for the destination device to migrate both its current load, and the migrated load.

* **How can SDN be implemented for ad hoc?**

Source: Paul Baskett, Yi Shang, and Wenjun Zeng and Brandon Guttersohn. *Software-Defined Networking in Ad hoc Networks of Smartphones.*

In this paper, SDN has been implemented as an application in a smart phone. The prototype is based on networking services in the application layer on each node. AODV (Ad Hoc On Demand Distance Vector) over Wi-Fi is implemented as the underlining networking service. Tracking is done through periodic hello packets (it uses route request, route reply and route error). Android Interface Definition Language (AIDL) is used for inter-process communication between the layers of SDN (communication layer, network operating system (NOS), and control program).

The NOS sends/receives application packets and maintains a network map by scanning the network periodically to generate a network map.

* The first node labels itself as the original requester, adds itself to the blacklist, and adds a series of pairs to the global view table. Each pair contains the original node itself and one of its single-hop peers.
* When a peer receives the packet, it adds pairs representing its single-hop peers, blacklists itself, and continues forwarding to its peers that are not already blacklisted.
* The original node collects responses from other nodes to build an adjacency list, representing the whole network.

Each user application could run in its own logical network (with a unique logic network tag), making it easy to implement application specific routing rules and better manage network resources across applications. A logical network manager in the NOS, which maintains a set of logical network objects. All application data sent through the network must be done via a logical network object, which defines a network tag and a set of node members.

A control program is implemented which communicates with NOS using an INetworkOS AIDL interface. The control program first initializes and configures the ad hoc network. The user can view the network map and update it by changing routing rules through network management portion.

Source: Ian Ku. *Software-Defined Mobile Cloud*

In the paper, the simulate SDVN routing over a SUMO generated road network. Node density varies is 50 nodes in the simulation. The SDVN controller LTE access is placed in the center of the simulation area where it is in wireless range of all SDN wireless nodes. Each SDVN wireless node has multiple wireless interfaces; short range using 802.11 with the propagation loss model to limit the transmission range to 250m, and long range using LTE. Package Delivery Ratio for nodes varying from 30-50 nodes have been calculated. The paper makes a comparison between traditional ad hoc protocols and SDN based. PDR varying speeds of nodes have been calculated.

**Is it beneficial in terms of migration?**

I could not find papers specific to migration. But in the above paper (Software-Defined Mobile Cloud), when compared to other ad hoc routing protocols, SDN has performed better.