NCM: The Integration Approach for NN-VANETs

G.Vijayalakshmi, R. Deepa, S. Subash Prabhu, M. Anjelin Nithya Devi

Abstract - **Mobility management is one of the most challenging research issues for VANETs to support Intelligent Transportation System (ITS) applications such as infotainment, internet access and video streaming. The NEMO centric approach is used to integrate the NEMO protocol with VANETs. The combination of NEMO protocol with VANET supports communications between RSUs and vehicles to provide internet access. The Nested NEMO based VANETs has the problem of high routing delay. NEMO Centric Approach is suitable for Nested NEMO based VANETs to challenge the high routing delay. The main goals of the proposed system are to support global internet access and session continuity as well as to support multihop communication. The simulation is accomplished by the integration of VANET MOBISIM (MOBIlity SIMulation) Tool and NS-2(Network Simulation) Tool. The X-graph is used to analyze the performance of the network.**

Key Terms: Mobility Management, NEMO Protocol, Nested NEMO, Routing Delay, VANETs

I. INTRODUCTION

The fiery growth of Internet applications combined with pervasive availability of mobile devices such as laptop and palmtop. Computers have created an increasing demand for mobility support for moving nodes. Mobile wireless networks have developed to be incorporated with IP-based infrastructure for ITS applications such as infotainment, video streaming and multimedia, where mobility support has become a major issue.

The integration of NEMO with VANETs [1] supports the communication between the Road Side Unit(RSU) and vehicles. These communication supports the ITS applications such as infotainment, internet access, video streaming [2].

Due to having the goal of global internet connectivity and session continuity, the Mobility management protocols [3] can be classified into host and network based protocols. In host based mobility management protocols such as MIPV6 [4], the Mobile Nodes can manages its own mobility and it doesn't depends on the other network entities such as routers.

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Network based mobility management protocols such as Proxy MIPV6 (PMIPV6) [5], the Mobile Nodes can manages its own mobility by using the network entity such as routers without the knowledge of Mobile Nodes. In addition NEMO protocol [6] is an extension of the host based mobility management protocols (MIPV6) to manage the mobility of moving network as one unit. The proliferation of Wi-Fi hotspots with in the vehicle is known as the NEMO based V ANETs [7] – [10]. Each vehicle is equipped with the On Board Unit (OBU). In NEMO based VANETs, the OBU will works as a Mobile Router (MR) to support mobility of the group of Mobil**e** Network Nodes (MNN) as one single unit.

The integration NEMO with VANETs deals with two ways such as MANET- Centric and NEMO – Centric approaches. The MANET centric approach is suitable for the scenario NEMO based VANETs and the NEMO – Centric Approach is very suitable for the scenario Nested NEMO based VANETs. Therefore this work mainly focused with NEMO – Centric model for the integration.

The rest of the article is organized as follows: Section II describes the preliminaries of the work which includes the overview of NEMO based VANETs, NN-VANETs and the NEMO BS protocols. System Model for the proposed system is detailed in the Section III. Section IV shows the effective simulation results and analysis. Finally, the Section V draws the conclusions and the future work of this article.

II. PRELIMINARIES

A. *NEMO Based VANETs*

In general, the deployment of Wi-Fi hotspots with in the vehicle is known as NEMO Based VANETs and in practical, the implementation of NEMO Basic Support (NEMO BS) protocol with VANETs are referred NEMO Based VANETs. In this scenario, the OBU of the vehicle also act as a MR and manages the mobility of all MNNs within the vehicle with required communication range.

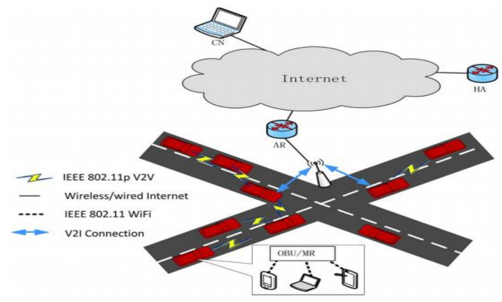

Fig.1. NEMO based VANET

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NEMO Based VANETs is illustrated on the figure 1. The two types of communications such as Vehicle to Vehicle (V2V) communication and the Vehicle to RSU (V2I) communication are also depicted in the figure 1.

B. Nested NEMO Based VANETs

The hierarchy type of NEMO based VANETs are called Nested NEMO based VANETs (NN-VANETs) in which, the OBU of each vehicle works as a MR and manage the mobility of all other MNNs with the vehicle and in addition, the MR of one Vehicle can control the mobility of other MR of another vehicle and so on. ie.., the hierarchy forms on the mobility management of individuals by others. NN-VANETs is illustrated on the figure 2.

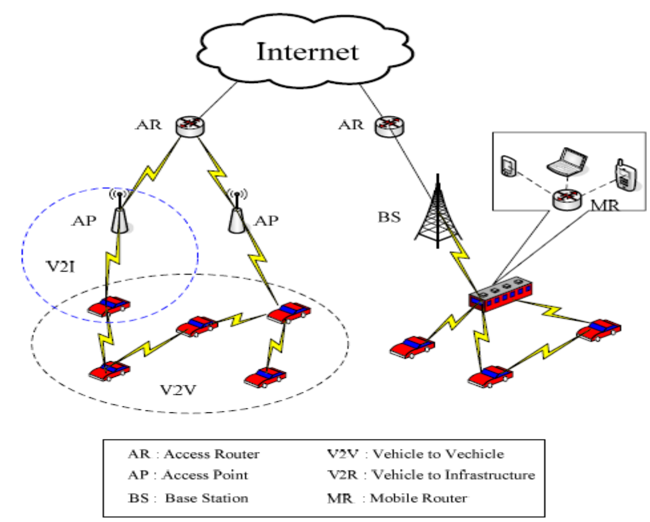

Fig.2. NN-VANETs

C. NEMO BS Protocol

The NEMO Basic Support (NEMO BS) protocol [11] is the standard protocol to manage mobility in the entire moving network. As an extension of the mobile IP protocol [12], [13], NEMO BS employs mobile IP's basic functionalities, such as the home binding updates; however, these functionalities are performed by the MR rather than the MNNs, which only implement the basic IP protocol without being aware of the entire NEMO.

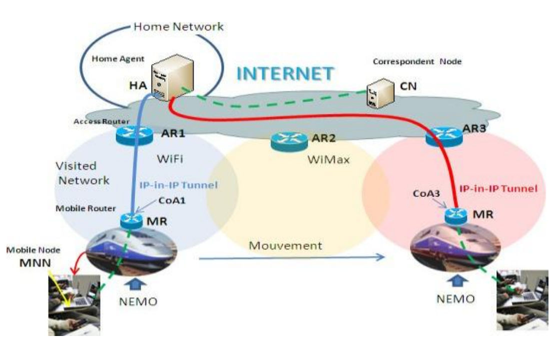

Fig.3. NEMO BS Protocol

Supporting the network's MNNs with the required mobility, NEMO BS has some benefits over the MIP protocol, such as reducing signaling overhead and mobility costs. In NEMO BS, the MNNs do not need to implement any mobility protocols, and it is designed to support a single-hop mobile network where there is a direct communication between an MR and the Internet access router.

III. SYSTEM DESIGN

A. NEMO BS Protocol Design

NEMO is an extension of Mobile IP that enables an entire network to change its attachment point to the Internet. Under NEMO, a Mobile Router (MR) takes over the role of the MN in performing mobility functions. Node that are attached to a MR, Mobile Network Nodes (MNNs), are not aware of the network's mobility and do not perform any mobility functions. MRs also sends binding updates to their HAs.

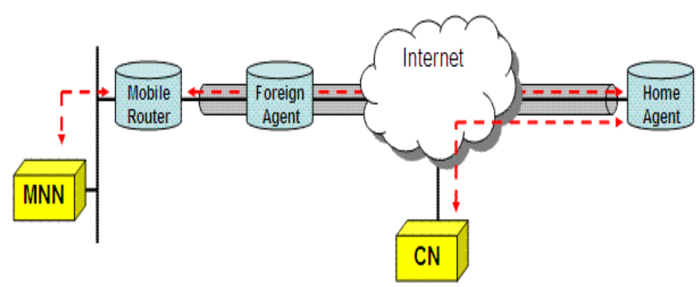

Fig.4. IP traffic between MNN and the corresponding node using NEMO

However, binding updates from MRs also contain the mobile network's network prefix. HAs will bind an entire network prefix to the MR's CoA and forward all packets for that network to the MR. Figure 4 demonstrates the path of packets using NEMO IP packets from a correspondent node (CN) that are destined for a node on a mobile network (MN) are delivered via standard routing on the Internet to the HA of that MN.

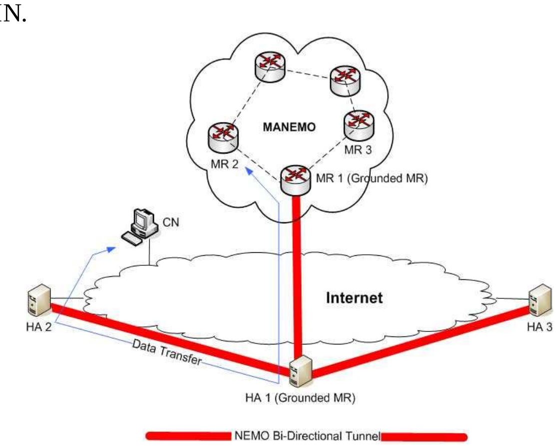

Fig. 5.Protocol Design of NEMO BS

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The HA tunnels the packets to the MR for delivery to the MNNs. Reverse packets take the same path in the opposite direction; the MNN sends packets to the MR to be tunneled to the home agent and then sent out to the CN via standard routing on the Internet. Figure 5 illustrates the protocol design for NEMO BS.

B. Implementation of NEMO BS Protocol

As the design consideration of NEMO BS protocol, the implementation steps will be takes place as follows:

STEP 1: MR2 joins in the network (MANEMO) on MANET Interface (ad-hoc)

- Hello Messages sent to local neighbors

STEP 2: If NEMO interface down

- MR2 performs Bind process with its HA over its MANET interface, via HA of the Grounded MR
- HA1 performs proxy Bind with HA2 on behalf of MR2
- MR2 learns of HA1's address via Gateway info message
  - HNA message in OLSR

STEP 3: Packet arriving at MR2's Home Network are subsequently forwarded toward the MANEMO

STEP 4: If MR1 moves access network, tunnel between HA1 and HA2 will not be removed

- Unless MR2 receives new address in gateway message or BU times out

STEP 5: Grounded MR's HA maintains connections to other HAs

- Route could be optimised to Grounded MR
- Too heavy burden on MR

C. NEMO – Centric Model (NCM)

The NEMO-centric approach depicts on the figure 6. in which, multi-hop communications are created by implementing the NEMO BS on both the intermediate and sender vehicles [14]. In addition to working as an MR, each OBU in the intermediate V2V2I communication path also works as a gateway for the moving-network's MR.

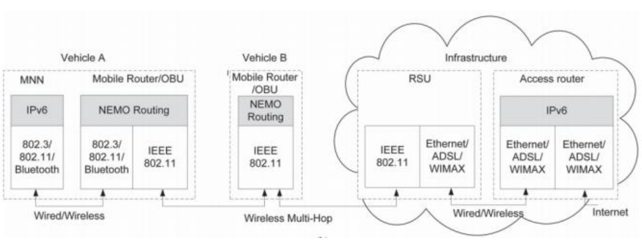

Fig. 6. NCM: The integration approach

The NEMO-centric approach [15] is more appropriate for nested NEMO and hierarchical structured networks, whereas the MANET-centric approach is more suitable for our scenario, in which the ad hoc structure is implemented in the multi-hop communication

IV. SIMULATION RESULTS AND ANALYSIS

In this section, an NS-2 simulator is used to investigate the performances of NEMO protocol and compare it to MANET centric protocols.

A. Network models and Parameters

The parameters and the values are given in the Table.1 for the performance analysis of NEMO protocol. The mobility of the node in the network are achieved by using the VANET MobiSim tool with Random way point mobility model.

Platform	Red – hat
NS version	Ns-allinone-2.34
Pause time	0-900s
Simulation time	200s
Number of nodes	50 wireless nodes
Traffic	CBR
Packet size	1024 bytes
Transmission Range	250m
Simulation Area	1500X300m
Node Speed	20m/s
Mobility model	Random waypoint

Table.1 Simulation Parameters for NEMO

B. Simulation Environment

The simulation environment can be achieved by the use of nam operations in NS2. Here 52 nodes are created with mobility in which, two red color nodes are indicated the attackers presented on the network. One pick color indicates the RSU. Four blue nodes are representing the Access point of the system which helps the vehicles to communicate with the RSUs. Packets are transmitted among the nodes shown in fig.7.

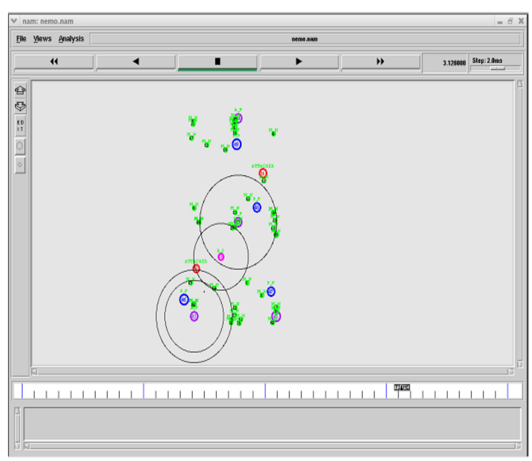

Fig.7 . Simulation Environment

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C. *Anonymity*

The anonymity could be analyzed by the use of MANET Centric Model (MANTET Routing Protocols such as AODV) which suitable for NEMO based VANETs and NEMO centric model (NEMO BS Protocol) which is well suited for the scenario NN- VANETs. Anonymity is the metric that makes the user to continuously getting service from the internet by blocking the trace – ability of the MNNs or it makes more difficult to analysis the traffic. It prevents the network analysis from the attacker to improve the performance. so, NEMO achieves higher anonymity range rather than others shown in fig.8 .

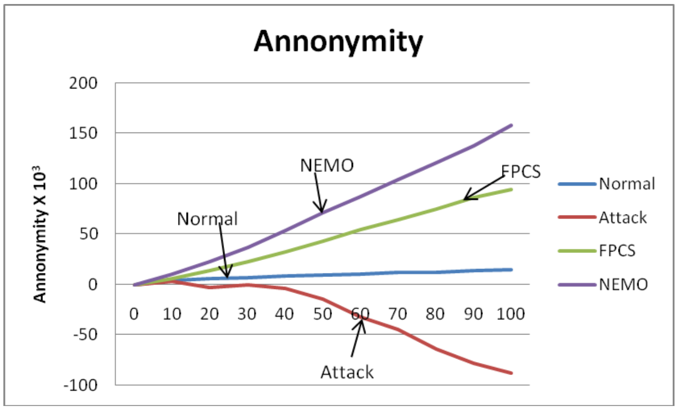

Fig.8. Anonymity Analysis

Anonymity can be calculated by using the terms of request and response parameters such as RTR,MAC as follows:

$$anonymity = \sum_{i=1}^{k} RTR - MAC \quad --------(1)$$

Where
RTR- Request parameter
MAC – Response Parameter

D. *Energy Spent*

In VANET, energy limitation is not a major consideration, but the attacker nodes are attack the MNNs by increasing the consumption of MNNs. High energy nodes are affected by the attackers and disturb the network usage. NEMO protocol supports the MNN's energy and thus by makes the continual sessions. Fig.9. shows the lower level enegy spent by the MNNs. Energy spent by the MNNs are calculated as follows:

$$Ec = \frac{ie - fe}{ie} \quad -------------(2)$$

$$AEC = \sum_{i}^{k} Ec/N_i \quad --------------(3)$$

Where
Ec – Percentage of Energy consumed
ie – Initial energy
fe – final energy
AEC – Average Energy Consumed by the MMNs
N_i – Number of nodes

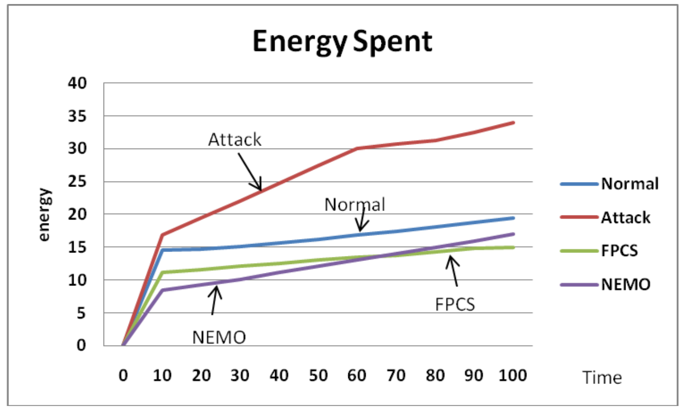

Fig.9. Energy Spent Analysis

E. *Throughput*

In case attacker present at the network will degrades the network performance. the analysis depicted in the figure . for normal without the attacker, attacker present, the privacy preserving scheme on MANET routing protocol and NEMO. Among them NEMO achieves greater throughput that reflects on the fig.10 .

$$Throughput = \sum \frac{t(nodes)}{N} \quad -----(4)$$

Where
t(nodes) – throughput of nodes involved in data transmission
N- Number of nodes

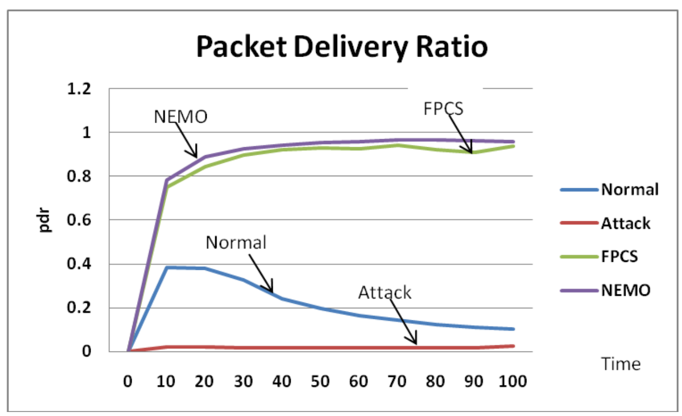

Fig.10 . Throughput Analysis

F. *Packet Delivery Ratio*

PDR can be derived from the ratio of the number of received packets by the number of transmitted packets to be received and sent from/to the server respectively. NEMO yields the largest PDR value than others which is shown in the fig.11. And the PDR is calculated as follows:

$$pdr = \frac{n(rp)}{n(tp)} -----------(5)$$

Where
Pdr- packet delivery ratio
n(rp) – number of received packets
n(tp) – number of transmitted packets

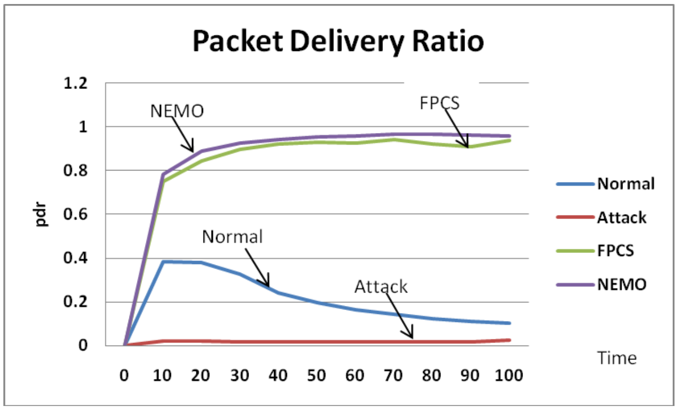

Fig.11.PDR Analysis

G. Average Delay

The end-to-end delay is the time taken for a data packet to reach the destination node. The delay for a packet is the time taken for it to reach the destination. And the average delay is calculated by taking the average of delays for every data packet transmitted.

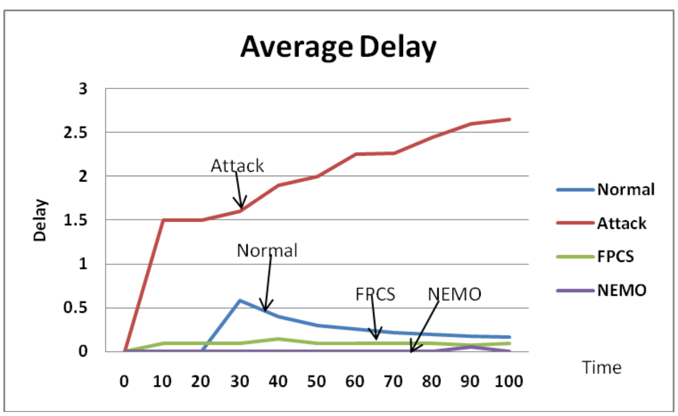

Fig.12.Analysis of Average Delay

The parameter comes into play only when the data transmission has been successful. The following figure depicts the delay analysis by the network. Equation (6) and (7) are used to calculate the average packet delay.

$$pd = rt_{destn} - tt_{source} --------- (6)$$

$$d = \sum \frac{pd}{n(rp)} ----------(7)$$

Where
pd - packet delay
rt_{detn} – receive time at destination
tt_{source} – transmit time at source
d – average delay
n(rp) – total number of received packets

V. CONCLUSION AND FUTURE WORK

In this work, NEMO centric approach is used to integrate the NEMO protocol with VANETs. NEMO BS protocol is implemented to provide the basic functionality of the mobile IP. This work mainly concentrates on the mobility management of the moving network. Finally, the routing delay could be 55% – 60% improved than the MANET centric Approach in NEMO based VANETs using MANET routing protocol such as AODV by the use of tunneling concept, through the design principles of NEMO BS protocol.

In future, this work will be continued on the basis of Routing management in the scenario ie.., NN-VANETs. For that NEMO Routing Protocol will be used to achieve the low routing delay when multi-hop communication is performed by the NN-VANETs.This work may also be continued with cryptographic technique to authendicate an MN within the vehicle in heterogeneous wireless networks where different wireless access technologies are integrated is an important issue in NN-VANETs.

REFERENCES

[1] Sanaa Taha and Xuemin (Sherman) Shen, "A Physical-Layer Location Privacy-Preserving Scheme for Mobile Public Hotspots in NEMO-Based VANETs", *IEEE Trans. On ITS* May 26, 2013.

[2] Y. Peng and J. Chang, "A novel mobility management scheme for integra-tion of vehicular ad hoc networks and fixed IP networks," Mobile Netw. Appl., vol. 15, no. 1, pp. 112–125, Feb. 2010.

[3] E. Perera, V. Sivaraman, and A. Seneviratne, "Survey on network mobility support," SIGMOBILE Mobile Comput. Commun. Rev., vol. 8, no. 2,pp. 7–19, Apr. 2004.

[4] S. Taha and X. Shen, "Anonymous home binding update scheme for mobile IPv6 wireless networking," inProc. IEEE GLOBECOM, Houston, TX, USA, Dec. 5–9, 2011, pp. 1–5.

[5] S. Taha, S. Cespedes, and X. Shen, "EM3A: Efficient mutual multi-hop mobile authentication scheme for pmip networks," inProc. IEEE ICC, Ottawa, ON, Canada, Jun. 10–15, 2012, pp. 873–877.

[6] S. Taha and S. Shen, "A link-layer authentication and key agreement scheme for mobile public hotspots in NEMO based VANET," inProc. Globecom CISS, Anaheim, CA, USA, Dec. 2012, pp. 1004–1009.

[7] J. Lorchat and K. Uehara, "Optimized inter-vehicle communications using NEMO and MANET," inProc. 3rd Annu. Int. Conf. Mobile

Ubiquitous Syst.: Comput., Netw., Services, San Jose, CA, USA, Jul. 17–21, 2006, pp. 1–6.

[8] R. Baldessari, A. Festag, and J. Abeillé, "NEMO meets VANET: A deployability analysis of network mobility in vehicular communication," in Proc. 7th IEEE Int. Conf. ITST, Sophia Antipolis, France, Jun. 6–8, 2007, pp. 1–6.

[9] S. Cespedes, X. Shen, and C. Lazo, "IP mobility management for vehicu-lar communication networks: Challenges and solutions,"IEEE Commun. Mag., vol. 49, no. 5, pp. 187–194, May 2011.

[10] A. Prakash, S. Tripathi, R. Verma, N. Tyagi, R. Tripathi, and K. Naik, "Vehicle assisted cross-layer handover scheme in NEMO-based VANETs (VANEMO),"Int. J. Internet Protocol Technol., vol. 6, no. 1/2, pp. 83–95, Jun. 2011.

[11] V. Devarapalli, R. Wakikawa, A. Petrescu, and P. Thubert, RFC 3963: Network Mobility (NEMO) Basic Support Protocol, 2005. [Online].Available: http://tools.ietf.org/pdf/rfc3963.pdf

[12] C. Perkins, "RFC 3344: Ip mobility support for IPv4," Network Working Group, 2002. [Online]. Available: http://tools.ietf.org/html/rfc3344

[13] D. Johnson, C. Perkins, and J. Arkko, "RFC 3775: Mobility support in IPv6," IETF, Jun. 2004. [Online]. Available: http://tools.ietf.org/html/

[14] R. Baldessari, W. Zhang, A. Festag, and L. Le, "A MANET-centric solu-tion for the application of NEMO in VANET using geographic routing," inProc. 4th Int. Conf. Testbeds Res. Infrastruct. Dev. Netw. Communities, Innsbruck, Austria, Mar. 18–20, 2008, p. 12