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A SIMULATION ANALYSIS OF MOBILITY MODELS FOR NETWORK MOBILITY ENVIRONMENTS

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ABSTRACT

In real world scenarios, there is an increasing concern in placement as well as assessment of mobility management protocols for Network Mobility (NEMO). Mobility models have a substantial impact on the performance evaluation of any new mobility management protocol in NEMO. A considerable assessment of any protocol and comparison with other equivalent protocol cannot be completed without making use of an accurate mobility model. The choice of the mobility model can majorly affect the performance assessment of mobility protocols. As a result, it is really essential to pick a detailed mobility model which correctly symbolizes the movement pattern of Mobile Routers (MRs). This paper details the most prevalent mobility models utilized such as Random Way Point (RWP) and Constant Velocity (CV) mobility model to characterize the MR mobility rate in NEMO. After that, Network Simulator version 3 (NS-3) simulation results will be presented using movement pattern of MR as well as road maps to show the significance of selecting an appropriate mobility model on PMIPv6 domain in NEMO (PNEMO) environment.

Keywords: NEMO, PNEMO, RWP mobility model, CV mobility, MR.

INTRODUCTION

Recently, the deployment as well as significance of wireless access networks has developed promptly. Network Mobility plays an important role in this concern, and has motivated the improvement of several new facilities, such as Voice over IP (VoIP) [1-3]. In provision of these improvements, new mobility management protocols are offered by researchers in order to improve the overall handoff performance of wireless data networking amongst Mobile Routers (MRs). With the purpose of simulating the movement of MRs, different mobility models are used. Mobility models have a substantial impact on the performance evaluation of any new mobility management protocol in NEMO. A considerable assessment of any protocol and comparison with other equivalent protocol is not capable to be completed without making use of an accurate mobility model. Selecting an appropriate mobility model can considerably influence the performance estimation of Mobility Management (MM) protocols [4]. As a result, it is really essential to pick a detailed mobility model which correctly symbolizes the movement pattern of Mobile Routers (MRs) in NEMO environment.

The main goal of this paper is to detail the most prevalent mobility models to characterize the MRs mobility rate in NEMO. After that, using movement pattern of MR and road maps, it is presented simulation results to show the significance of selecting an appropriate mobility model in the NS 3 simulation of a mobility management protocol. The most prevalent mobility types utilized in NS3 are generally: Random Way Point (RWP) model and Constant Velocity (CV) mobility model [8-11].

The notable contributions of this paper includes: (i) qualitative analysis on two widely used mobility model (i.e. RWP and CV) to analyze handoff performance of MR in NEMO on network-based localized domain (i.e. PMIPv6) (ii) quantitative analysis to estimate as well as compare simulation results. This is to show the significance of selecting an appropriate mobility model in the NS 3 simulation of a mobility management protocol in terms of handoff delay.

The rest of the paper is structured as follows. Section 2 provides a brief overview of Mobility Management (MM) protocols which is followed by a comparative analysis on the RWP and CV mobility models in section 3. Section 4 offers a detailed analysis of the results achieved in performance estimations. Finally, the conclusion of the paper is presented in section 5. Research steps are summarized in Figure-1.

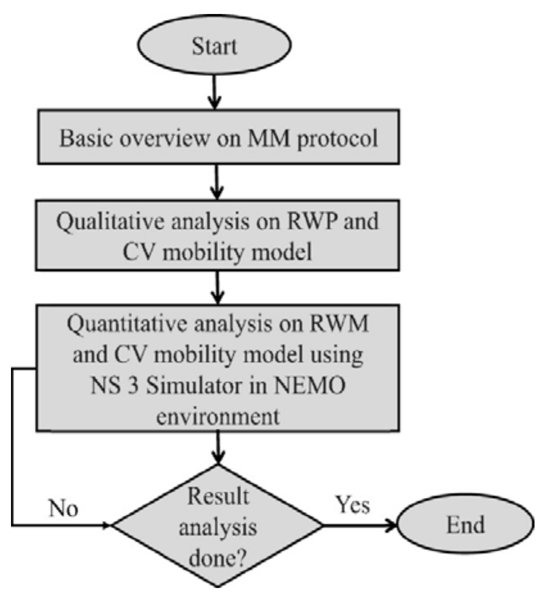

Figure-1. Summarizes the research steps.

OVERVIEW OF MM PROTOCOLS

Mobility Management (MM) is a major issue that supports Mobile Nodes (MNs) or Mobile Routers (MRs) during roaming to ensure continuous Internet connectivity in wireless networks. The most recognized mobility management protocols are categorized into network mobility and host mobility. The host mobility protocols such as MIPv6 and PMIPv6 allow only a single Mobile Node (MN) to be linked with the internet whereas the NEMO protocol (i.e. NEMO BSP) allow the entire network to be linked with the internet through Mobile Router (MR). The comparison of the network mobility and host mobility is represented in Figure-2. Moreover, in accordance with the scale, mobility management protocols at the network layer are specified into two vital approaches namely: Global Mobility Management (GMM) and Local Mobility Management (LMM) [5-7]. The Mobility Management classification is illustrated in Figure-3.

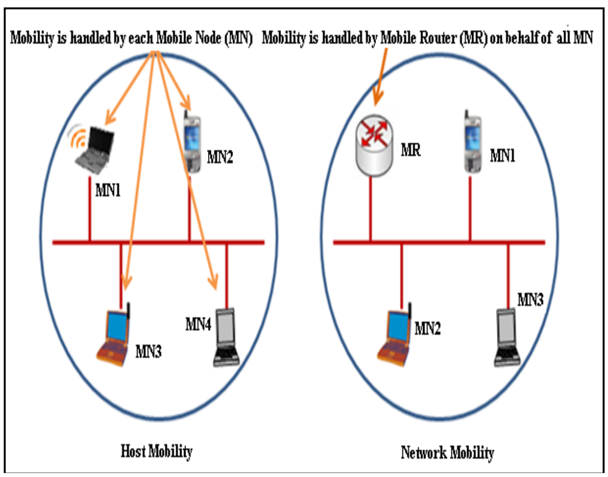

Figure-2. Host mobility and network mobility.

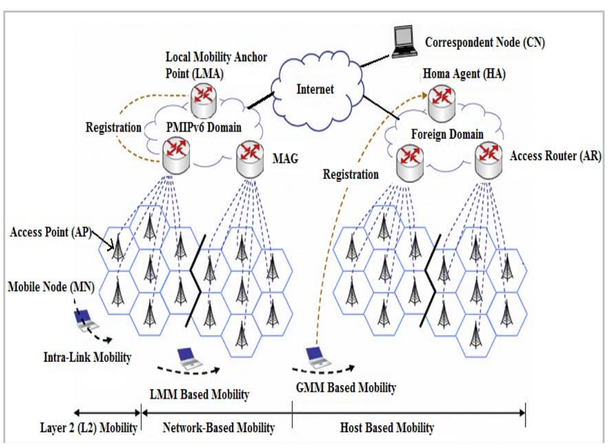

Figure-3. Classification of mobility management.

QUALITATIVE ANALYSIS

Mobility model need effort to monitor the mobility of real MR in mobile network. Mobility models are grounded on some essential parameters linked to MR mobility. These parameters include the initial position of MR, MR mobility route, speed range, speed variations over time.

Random Way Point (RWP) model is a renowned as well as mostly used mobility model [8-10]. This model has been proposed via Johnson and Maltz. It involves pause times among variations in direction and speed as shown in Figure-4. This is implemented within the network simulator (i.e. NS2, NS 3) and GloMoSim. This model is used to evaluate the performance of NEMO networks. It is easy to use as well as direct stochastic model that explains the mobility rate of a MR or MN in an individual system region. However, this model is not sufficient for high speed car-based movement in NEMO environment.

In contrast, Constant Velocity (CV) mobility model is used as a built-in-mobility models in NS3 [11]. According to the CV mobility model, MR continue along its initial speed direction for the period of the simulation as depicts in Figure-5. There is no geographical restrictions in CV mobility model.

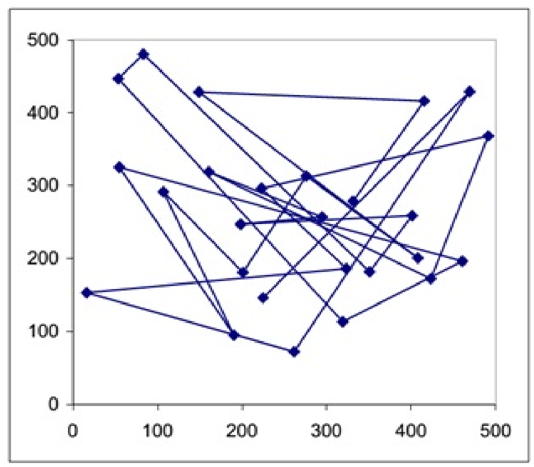

Figure-4. RWM mobility model.

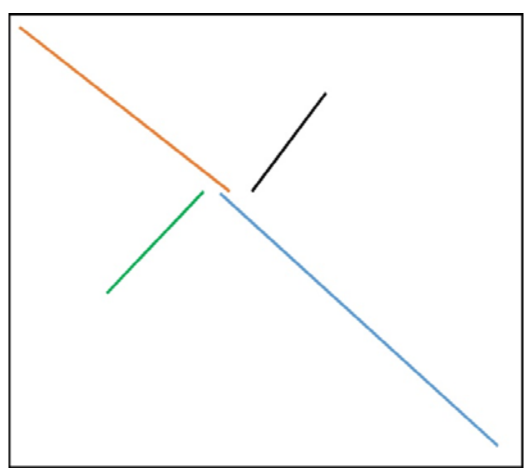

Figure-5. CV mobility model.

QUANTITATIVE ANALYSIS

This sub-section evaluates the performance of RWP and CV mobility models using Network Simulator version 3 (NS3). The NS 3 is a discrete-event network simulator for Internet systems [13]. NetAnim and gnuplot are used in order to analyze, visualize or process the data gained through simulation. The cycle of simulation steps using NS3 simulator are depicted in Figure-6.

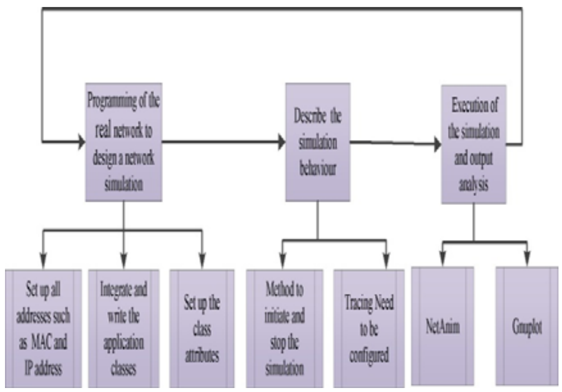

Figure-6. Simulation steps using NS3 simulator.

RESULT ANALYSIS

The considered scenarios of Proxy NEMO (PNEMO) networks contain of 20 MRs. The parameters are detailed in Table-1.

Table-1. Parameters for simulation analysis.

Parameters	Value
Simulator	NS3.12.1
Number of correspondent node	1
Operating system	Linux Ubuntu 12.04
Pause time	12 millisecond
Simulation time	[0-5] second
SMR speed	60 meter/second

Figure-7 and 8 shows the impact of changing time on average handoff delay of PNEMO for both RWP as well as CV mobility model. MR speed is kept constant at 60 meter/second. Indeed, the performance with these two models, the most common trend is that the handoff delay decreases with increasing the time. This is because, rising the time of MR leads to enhance network connectivity as well as lower handoff delay. Considering mobility management protocols (i.e. PNEMO), the average handoff delay of CV model provides the most stable and different results compared to RWP model. The average handoff delay of the CV mobility model has become smaller (.01 second) compared to RWP mobility model (.04 second).

From both figures, it is directed that the result achieved from the CV model for PNEMO is dissimilar than those acquired from RWP mobility model. Moreover, RWP mobility model is not efficient to use as an estimation to a practical model.

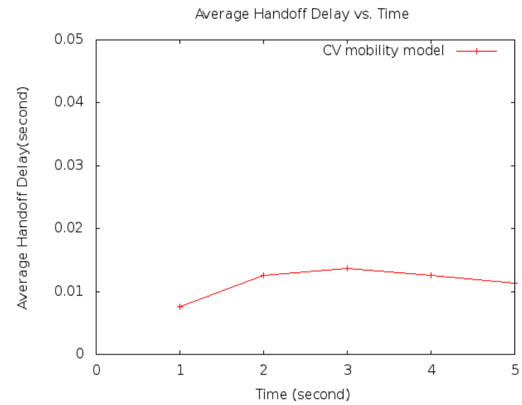

Figure-7. Handoff delay vs. time of PNEMO environment.

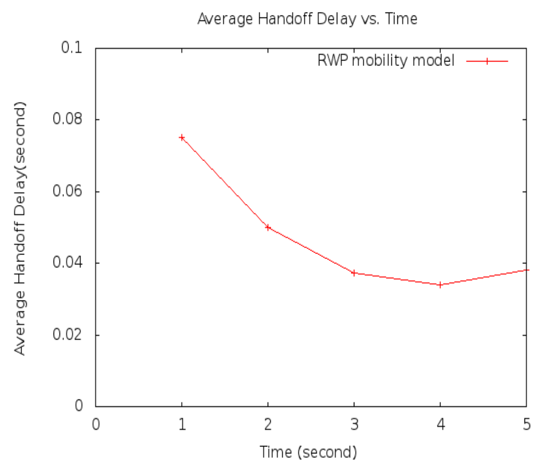

Figure-8. Handoff delay vs. time in PNEMO environment

CONCLUSIONS

In this paper, the performance of the mobility management scheme (i.e. PNEMO) is analyzed with respect to RWP and CV mobility models. In order to implement an extensive simulation scenario as well as the modelling of the PNEMO scheme, new code is integrated with the current modules in NS 3 simulator environment. Simulation results show that the signaling requirements for these two models are much different. It is also indicated that the comparative handoff delay of PNEMO scheme may vary depending on different mobility model.

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