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CHARACTERIZING NODE MOBILITY IN MANETS

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Abstract – In their previous work the authors had studied various combinations of MANET routing protocols and mobility models. The parameters of performance evaluation varied significantly with the choice of mobility models. Guided by these results, a new hybrid mobility model is proposed which appears more natural in a setting where MANETs are used. This hybrid model combines Reference Point Group Mobility (RPGM) in the initial phase, followed by the Random Waypoint Mobility (RWP) in the second phase. The hybrid model is tested with the three widely used routing protocols, DSDV, AODV and DSR, for varying MANET areas. The performance metrics used are Packet Delivery Ratio (PDR), end to end delay and throughput. The NS-2 simulation tool is used for the study. The results for the hybrid model are compared with the results for the RWP model, which is the default mobility model for MANETs. It is found that the hybrid model performed much better than RWP on all performance parameters, suggesting its use as a default mobility model in MANETs.

Keywords - MANETs, Routing Protocols, Random Way Point, Reference Point Group Mobility Model, PDR, Delay, Throughput.

I. INTRODUCTION

A mobile ad-hoc network (MANET) is an infrastructure-less, self-configuring, and autonomous collection of mobile nodes. The nodes are connected by wireless links. The network topology is unpredictable as the nodes move randomly. For this, efficient routing protocols have been designed to perform well in presence of the mobility of the nodes. The movement of the nodes is characterized by mobility models. The performance of the routing protocol varies with the mobility model used. There is a specific need for the most appropriate model that realistically mimics the movement of the MANET nodes.

In this study, AODV, DSDV and DSR routing protocols are considered. The main focus of the study is to suggest a novel hybrid mobility model. Performance evaluation of the three commonly used routing protocols is conducted with RWP and the hybrid model. The details about AODV, DSDV and DSR protocols, and RWP and RPGM mobility models can be found in the previous work of the authors [1] & [2].

This paper is organized in the following way. Section I gives a brief introduction of MANETs, its routing protocols and mobility models. In section II, the research works considering routing protocols vs. mobility models are summarized. The authors have proposed a novel hybrid mobility to characterize the movement of the nodes in section III. Simulation and performance evaluation is discussed in section IV. Results and discussions are in section V. Summary and conclusions are provided in section VI. At the end of the paper, references are listed.

II. RELATED WORKS

This section provides a brief review of the research works done in the area of MANET routing protocols and mobility models. A detailed literature review may be found in the previous works of the

authors, [1] and [2]. The related works follow next. Nand and Sharma [3] have compared reactive, proactive and hybrid protocols of MANETs. Ashish et al. [4] have evaluated the performance of OLSR, FSR and DSR protocols using Qualnet simulator. Sunil et al. [5] show the impact of the choice of mobility model on the performance of the routing protocols. The RWP, RPGM and FMM are compared for DSDV and AODV protocols by Gupta et al. [6].

The AODV, DSR and DSDV protocols with Gauss Markov, Manhattan Grid and RWP mobility models are compared by Bahuguna and Mandoria [7]. Almomani et al. [8] considered RWP and Boundless mobility models with Directional Greedy Routing Protocol and Mobility Based Adaptive Greedy Forwarding. Manzoor and Sharma [9] provided a review of some research works for routing protocols versus mobility models. Sharma et al. [10] presented simulation results for RWP, GM and RPGM mobility models with OLSR, DSR and ZRP routing protocols.

Wahed et al. [11] did performance evaluation of DSDV, OLSR and AODV protocols with varying speeds of nodes for RPGM and Manhattan Grid mobility models. Bharadwaj and Singh [12] considered DSDV, DSR, AOMDV and AODV protocols with Gauss Markov, Manhattan Grid and Random Walk Mobility, and emphasized the impact of mobility models on the performance of the MANET protocols. Shukla et al. [13] provided a choice of mobility models for the specified routing protocols as a result of simulation analysis for various combinations of mobility models and routing protocols. The impact of mobility using DSR and DSDV protocols is evaluated by Kumari et al. [14].

Zuahiri et al. [15] found that the performance of a protocol varies with choice of mobility models. The combinations of mobility models with routing protocols were suggested for better performance. The effect of node speed on Throughput and PDR is studied by Pal et.al [16] for RWP, RPGM and MGM mobility models. Singh and Dutta [17] used Gauss Markov, RWP, RPGM and MGM with DSDV, AODV and DSR protocols to see the effect of mobility models on the MANET performance. Umang et al. [18] have reviewed mobility models using real life applications which necessitated effective mobility management. Timcenko et al. [19] considered RPGM, RWP, GM and MGM mobility models with AODV, DSDV and DSR routing protocols to study PDR and delay.

Murthy and Das [20] used varying number of nodes and node speeds, RWP and RPGM mobility models, and AODV and DSR protocols to compare PDR, delay and throughput. Mann and Mazhar [21] suggested the protocol to use for given mobility model, MANET area and other parameters. Barakovic et al. [22] created node mobility scenario, varied pause time of the nodes, and did performance evaluation for DSDV, AODV and DSR routing protocols. Kumar and Rajesh [23] considered RWP, Random Walk and Random Direction mobility models to suggest the specific protocol to use with each of the mobility models. Agarwal et al. [24] varied network load and speed to evaluate PDR and delay for RWP, RPGM, GM and MGM mobility models.

All these works suggest one thing in common: that the mobility model has a significant effect on the performance of a MANET. However, these studies used diverse parameters with varied protocols and mobility models. To put it all together, the authors [2] performed a comprehensive study, and published performance metrics for mobility models and routing protocols combinations.

III. PROPOSED MODEL

As MANETs are widely used in emergency rescue operations during natural calamities, battlefield communication between soldiers and moving vehicles, event meetings, etc. a practical and convenient model should be used to characterize the mobility of the nodes. In such situations, to get a MANET in place, it seems only natural to send out some groups of nodes in the beginning, and allow them to move randomly in the area for some time. This can be modeled using the Reference Point Group Mobility (RPGM) model. In this setting, the nodes will communicate with the nodes within the group and the nodes outside the group. After some pre-decided time when the groups seem to have

settled, the individual nodes of each group are allowed to move randomly in the area. This second phase can be modeled using the Random Waypoint (RWP) mobility model.

The next task is to construct the hybrid mobility model described above. The scenario for time (t_1) may be generated using the RPGM model with 'n' nodes and 'a' groups. The scenario for time (t_2) is generated using the RWP model for n nodes. The two scenarios are combined in a way such that the final location of the nodes in first phase (time t_1) becomes the starting location for the second phase (time t_2) for each node. This hybrid model is compared against the RWP model which is the default mobility model for the scenario generation in NS-2 simulator.

IV. SIMULATION AND PERFORMANCE EVALUATION

For performance evaluation, Network Simulator (NS-2.34) is used. The scenario files of nodes movements are generated using Bonnmotion 2.0. The proposed hybrid model is generated in two phases. The scenario for the first phase is generated using the RPGM model, and for the second phase using the RWP model. Both phases are of 450 seconds each. The two phases are merged for a total scenario time of 900 seconds.

The simulation is done for two different network areas: small network of 500m x 500m and medium network of 1000m x 1000m. The number of nodes for simulation of small network are taken as 10, 20, 30, 40 and 50. And, the number of nodes for medium network are taken as 30, 40, 50, 60 and 70. The metrics of performance evaluation considered are:

Packet Delivery Ratio (%):

= (Total packets received / Total packets sent) X 100

Average End to End Delay (ms):

= $\sum$ (received time – sent time)/number of packets

The $\sum$ is over all received packets.

Throughput (kbps):

= (8/1000) $\sum$ (received size)/(stop time – start time)

Where start time is the start time of packet sending, and stop time is the stop time of packet sending. (8/1000) is used as a factor to convert to kbps.

V. RESULTS & DISCUSSIONS

The results of performance evaluation using NS-2 simulator are given in Figures 1 to 6. PDR, delay and throughput results for AODV, DSDV and DSR protocols are plotted. RWP model is compared against the proposed hybrid model which is indicated as RPGM+RWP in the figures. The PDR is far superior for the hybrid model than the default RWP model. This shows across all protocols and all network areas. The average end to end delay is much less for the hybrid model for the protocols considered and network areas. The throughput is higher for the hybrid model as against the RWP model for all protocols and network areas considered.

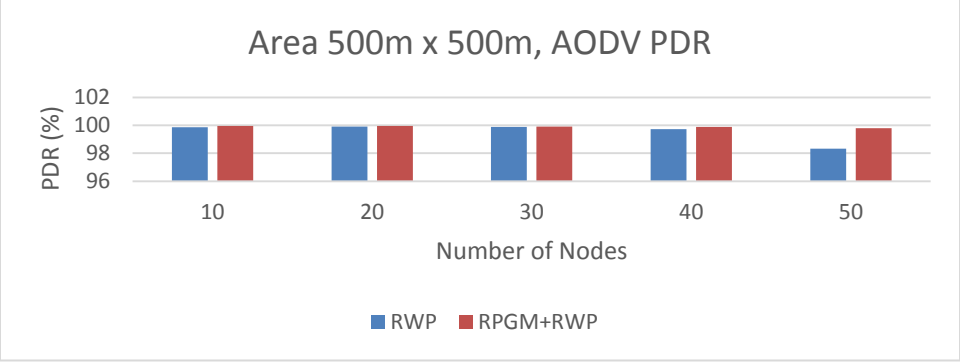

Figure 1(a): PDR vs. Nodes for 500m x 500m Network and AODV Protocol

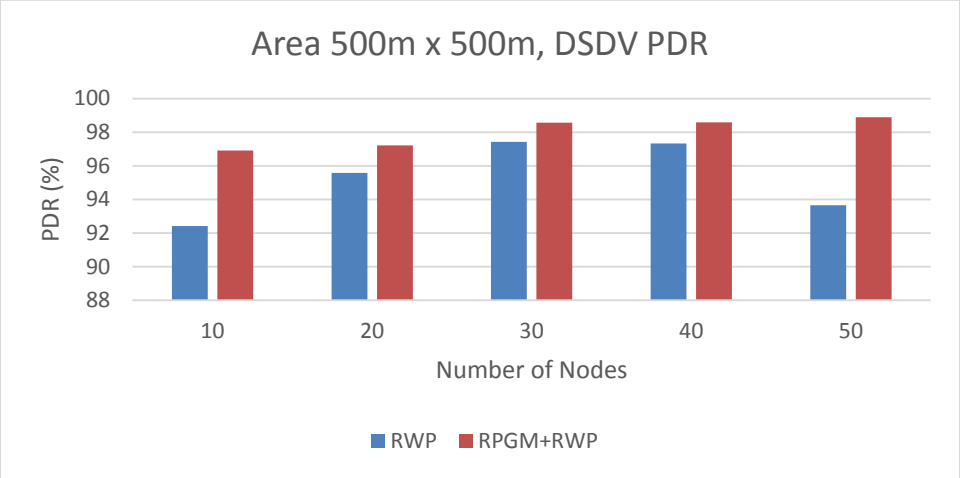

Figure 1(b): PDR vs. Nodes for 500m x 500m Network and DSDV Protocol

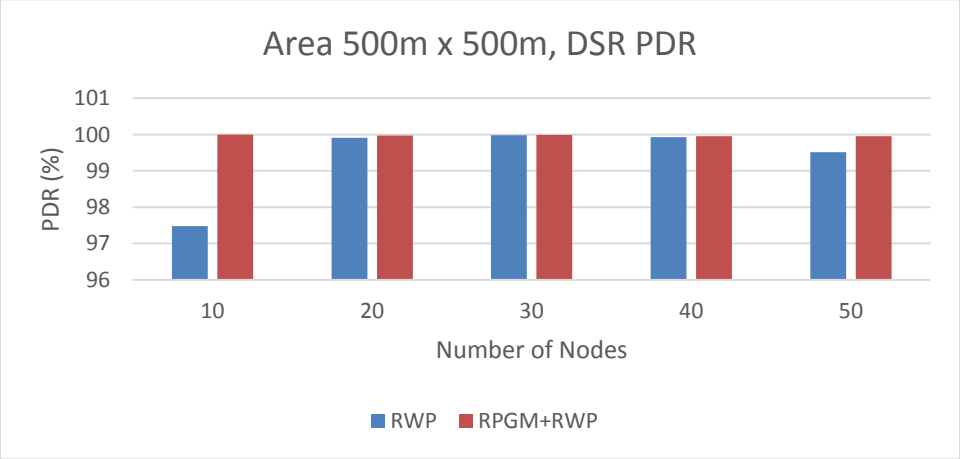

Figure 1(c): PDR vs. Nodes for 500m x 500m Network and DSR Protocol

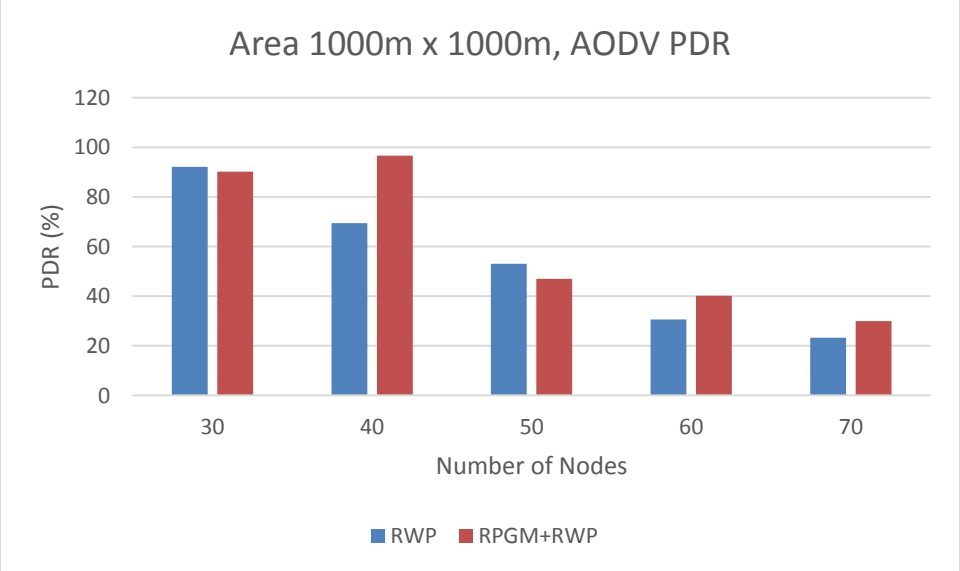

Figure 2(a): PDR vs. Nodes for 1000m x 1000m Network and AODV Protocol

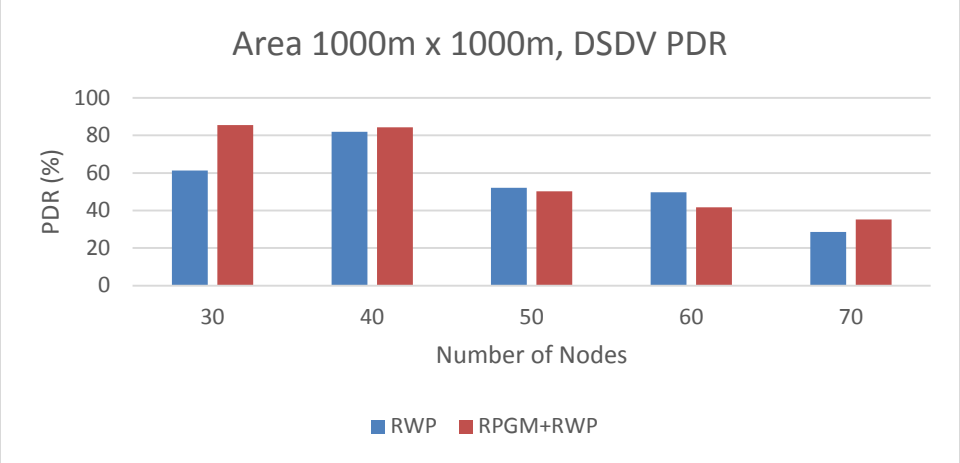

Figure 2(b): PDR vs. Nodes for 1000m x 1000m Network and DSDV Protocol

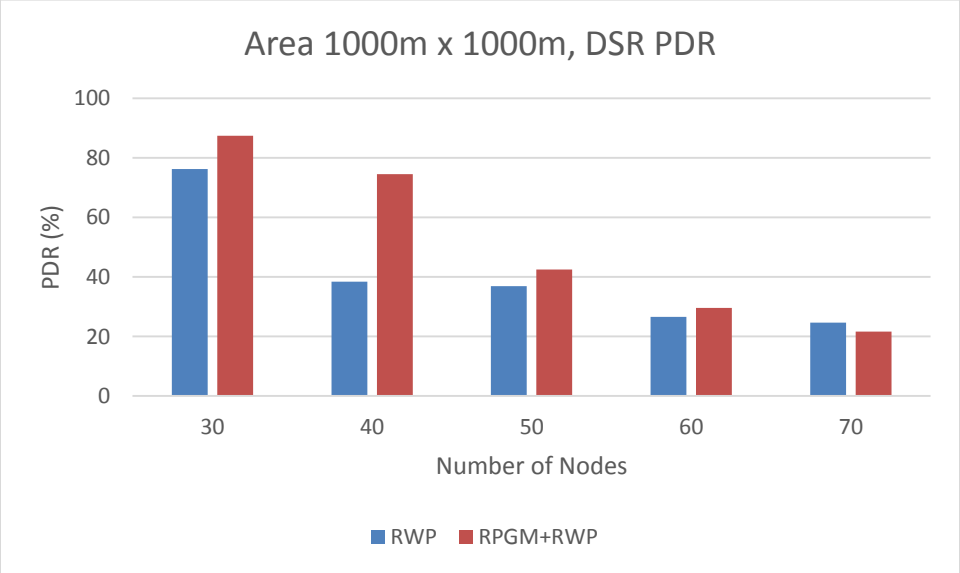

Figure 2(c): PDR vs. Nodes for 1000m x 1000m Network and DSR Protocol

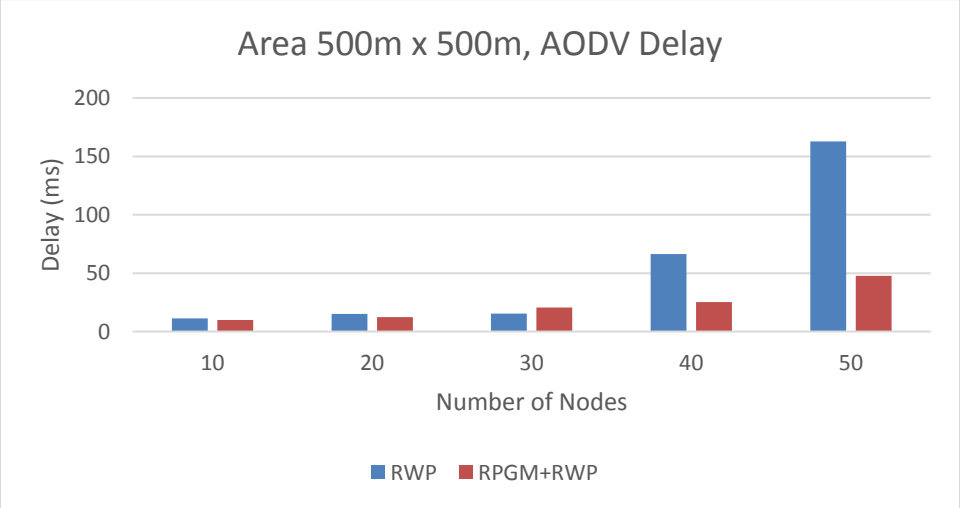

Figure 3(a): Delay vs. Nodes for 500m x 500m Network and AODV Protocol

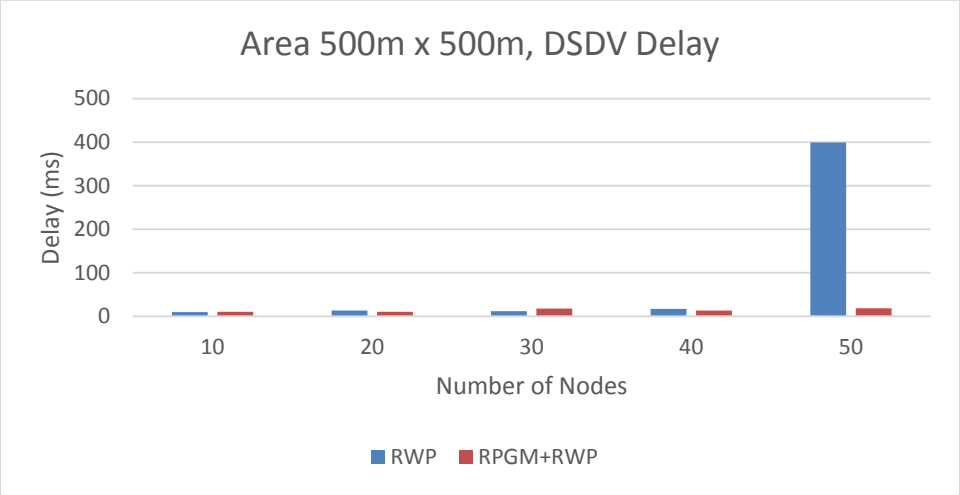

Figure 3(b): Delay vs. Nodes for 500m x 500m Network and DSDV Protocol

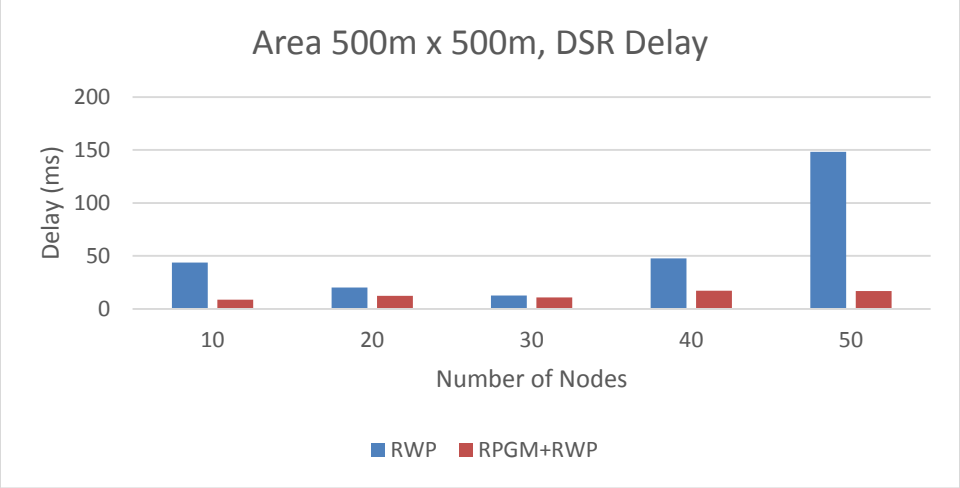

Figure 3(c): Delay vs. Nodes for 500m x 500m Network and DSR Protocol

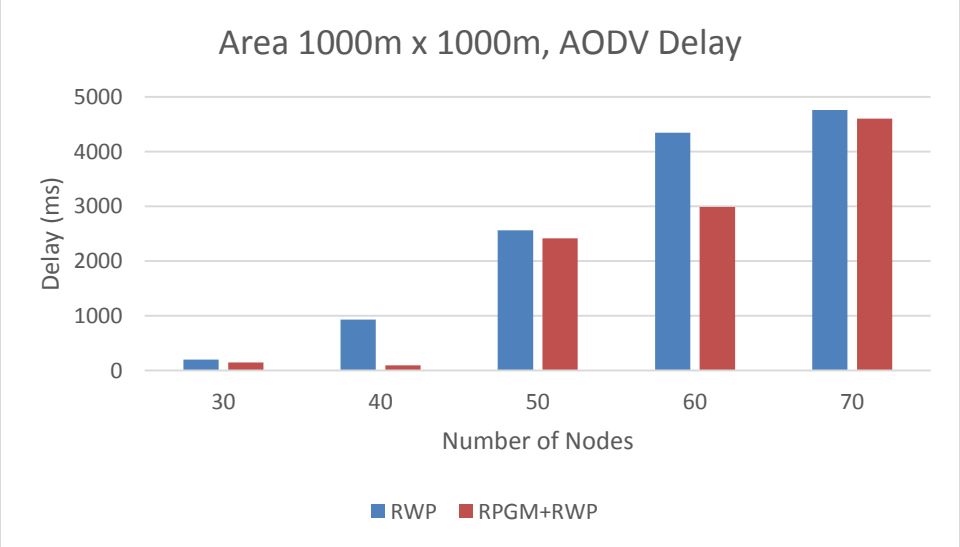

Figure 4(a): Delay vs. Nodes for 1000m x 1000m Network and AODV Protocol

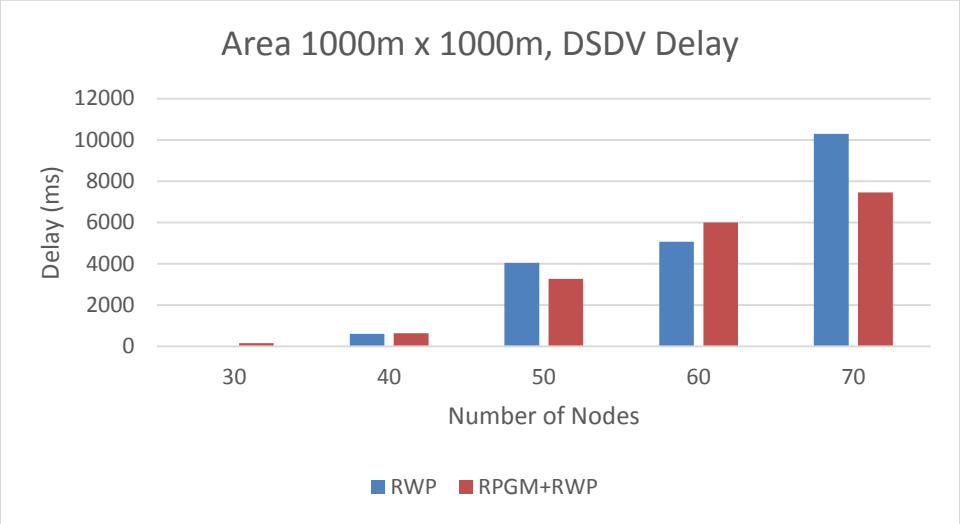

Figure 4(b): Delay vs. Nodes for 1000m x 1000m Network and DSDV Protocol

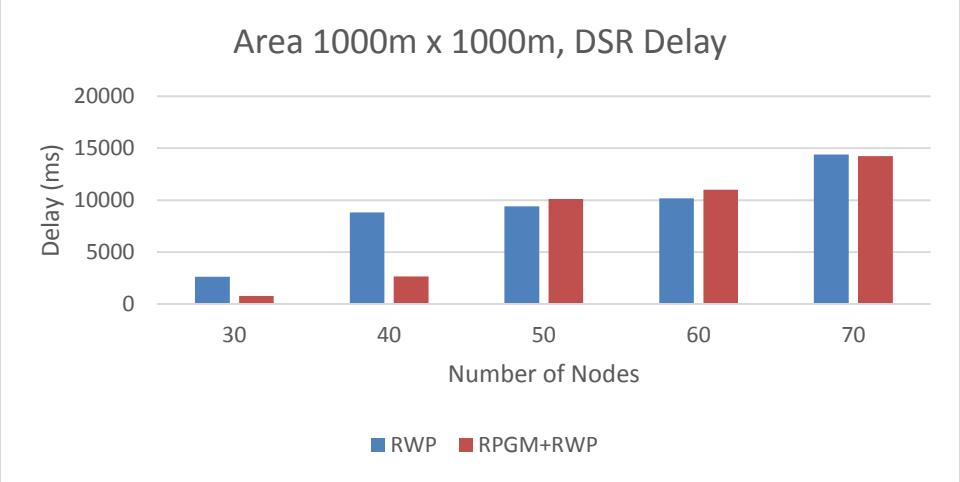

Figure 4(c): Delay vs. Nodes for 1000m x 1000m Network and DSR Protocol

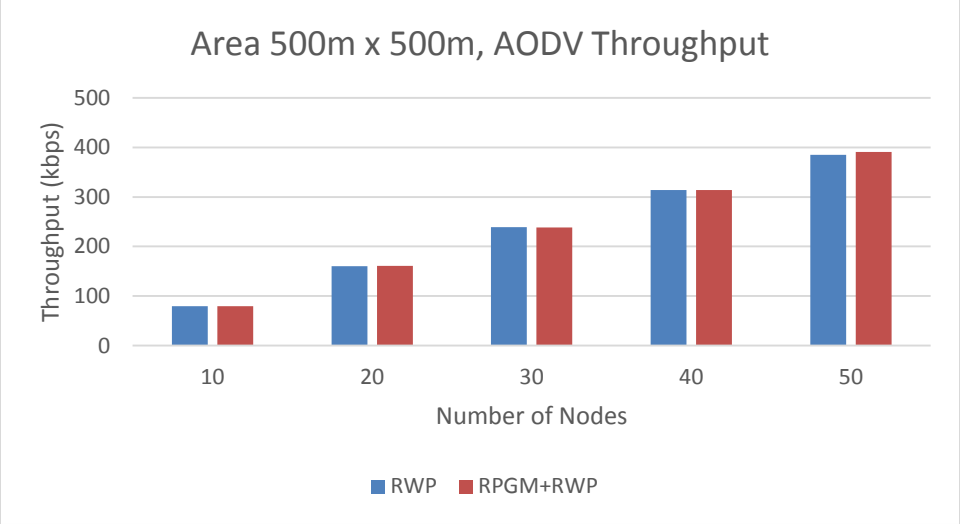

Figure 5(a): Throughput vs. Nodes for 500m x 500m Network and AODV Protocol

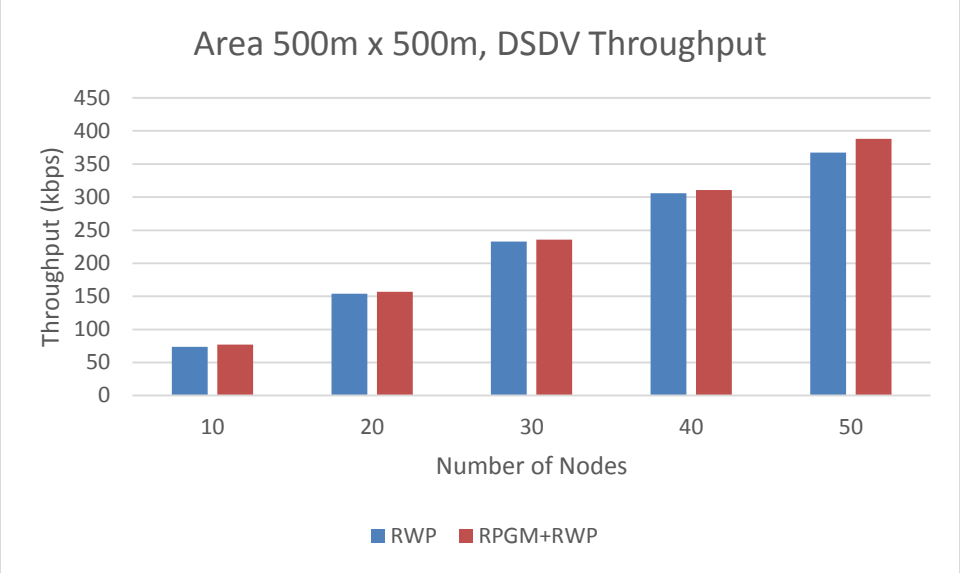

Figure 5(b): Throughput vs. Nodes for 500m x 500m Network and DSDV Protocol

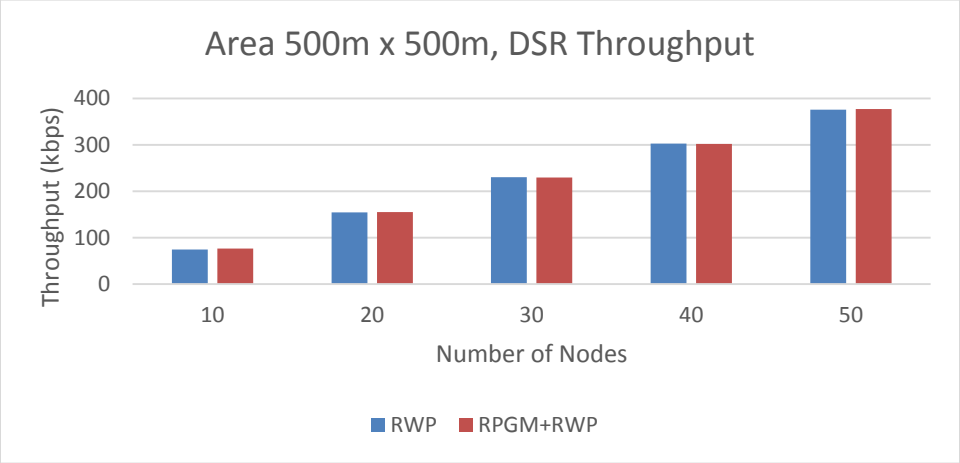

Figure 5(c): Throughput vs. Nodes for 500m x 500m Network and DSR Protocol

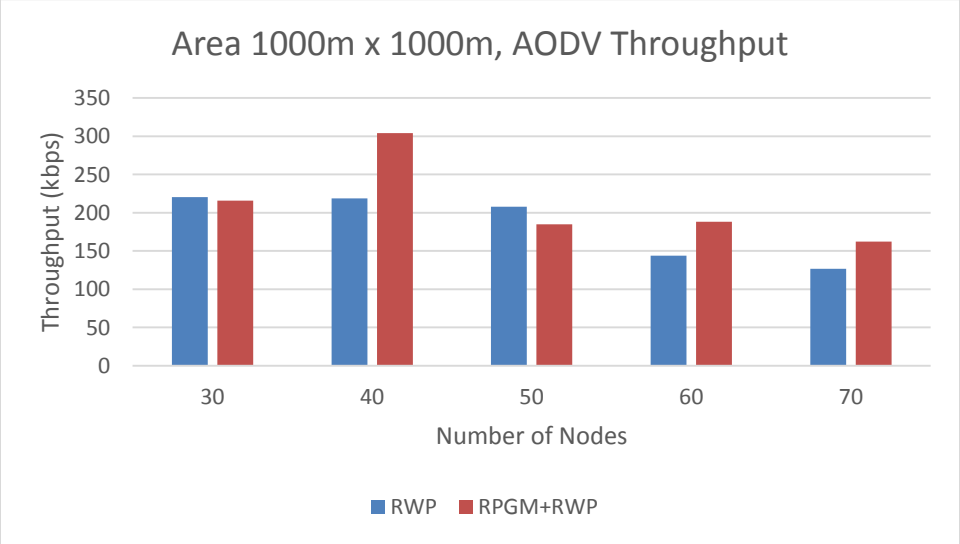

Figure 6(a): Throughput vs. Nodes for 1000m x 1000m Network and AODV Protocol

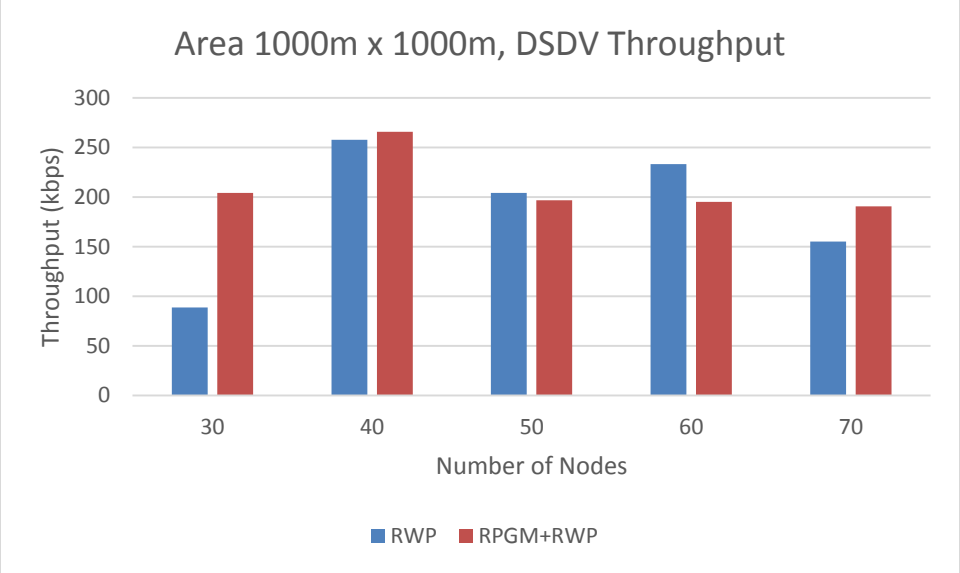

Figure 6(b): Throughput vs. Nodes for 1000m x 1000m Network and DSDV Protocol

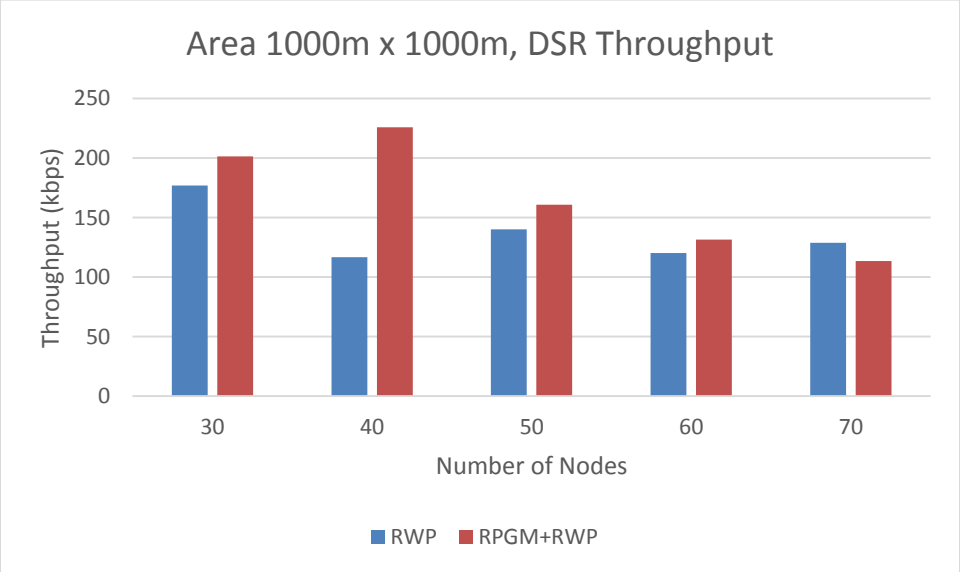

Figure 6(c): Throughput vs. Nodes for 1000m x 1000m Network and DSR Protocol

VI. SUMMARY & CONCLUSIONS

This work has attempted to characterize the mobility of nodes in MANETs. For this, a hybrid model consisting of two phases of random movements of nodes was proposed. In the first phase, the nodes moved randomly in groups following the RPGM mobility model. It was considered as a natural choice to start deployment of mobile nodes in the network area particularly in emergency rescue operations during natural calamities, battlefield communication between soldiers and moving vehicles, event meetings, etc. This allows for a possible scan of the area and settling time for the groups of nodes. In the second phase the nodes were freed from the groups and allowed to move randomly and individually. Nodes followed the RWP model in this phase.

The proposed hybrid model was compared against the RWP model for the widely used AODV, DSDV and DSR routing protocols for differing network areas. The performance metrics considered were: Packet Delivery Ratio, End to End Delay and Throughput. In all performance metrics, for all

network areas considered, and for all routing protocols considered the hybrid model outperformed the RWP model. Through this study, it is suggested that such a hybrid model should be used as a default model for scenario generation in NS-2

REFERENCES

[1] Suneet Shukla and Arvind Kumar Shukla. Mobility Models vs. Routing Protocols in NANETs: A Review. International Journal of Modern Trends in Engineering and Research, Vol. 03, Issue 01, pp 145-161, January 2016.
[2] Suneet Shukla and G. K. Banerjee. Performance Evaluation of MANET Routing Protocols under Different Mobility Models. International Journal of Modern Trends in Engineering and Research, Vol. 03, Issue 11, pp 191-209, November 2016.
[3] P. Nand , S. C. Sharma. Comparative Study and Performance Analysis of FSR, ZRP and AODV
[4] Routing Protocols for MANET. IJCA Proceedings on International Conference and workshop on Emerging Trends in Technology (ICWET), Vol. 2, pp. 14-19, 2011.
[5] A. K. Maurya, D. Singh, and A. Kumar. Performance Comparison of DSR, OLSR and FSR Routing Protocols in MANET Using Random Waypoint Mobility Model. International Journal of Information and Electronics Engineering, Vol. 3, no. 5, pp. 440-443, 2013.
[6] S. K.Kaushik, S. Singh, K.Chahal, S.Dhariwal Singh. Performance Evaluation of Mobile Ad Hoc Networks with Reactive and Proactive Routing Protocols and Mobility Models. International Journal of Computer Applications, Vol. 54, No.17, pp. 28-35, September 2012.
[7] A. K. Gupta, H. Sadawarti & A. K. Verma. Performance analysis of MANET Routing Protocols in different mobility models. International Journal of Information Technology and Computer Science (IJITCS), Vol. 6, pp. 73-82, 2013.
[8] Renu Bahaguna and Hardwari Lal Mandoria. Simulation Based Performance Comparison of MANET Routing Protocols Using Different Models and Node Density. International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 7 pp. 655-658, July 2015.
[9] Omar Almomani, Mahmoud Al-shugran, Jafar A. Alzubi and Omar A. Alzubi. Performance Evaluation of Position-based Routing Protocols using Different Mobility Models in MANET. International Journal of Computer Applications, Volume 119 – No. 3, pp. 43-48, June 2015.
[10] Aaliya Manzoor and Virender Sharma. A Survey of Routing and Mobility Models for Wireless Ad hoc Network. SSRG International Journal of Computer Science and Engineering, Pp. 46-50, April 2015.
[11] Munish Sharma, Manish Kansal, Tarunpreet Bhatia. Simulation Analysis of MANET Routing Protocols under Different Mobility Models. International Journal of Wireless Communications and Networking Technologies, Volume 4, No 1, pp. 1-8, December-January 2015.
[12] Mohamed Wahed, Hassan Al-Mahdi, Tarek M. Mahmoud and Hassan Shaban. The Effect of Mobility Models and Traffic Patterns on the Performance of Routing Protocols in MANETs. International Journal of Computer Applications, Volume 101 – No. 9, pp. 52-58, September 2014.
[13] Ashutosh Bharadwaj and Dr. Ajit Singh. The Performance and Simulative Analysis of MANET Routing Protocols with Different Mobility Models. International Journal of Computer Science and Information Technologies, Volume 5(2), pp. 2534-2539, 2014.
[14] Arvind Kumar Shukla, C. K. Jha and Shashi Kant Sharma. The Analysis of Mobility Models based on Routing Protocols. International Journal of Computer Applications. National Conference on Recent Trends in Engineering and Management "NCRTEM-2013", pp. 19-23.
[15] Aditi Kumari, Shrikant Upadhyay and Neha Gandotra. Impact of Mobility on the Performance of Wireless Network Scenario using Distance Vector Routing Protocol. International Journal of Computer Applications, Volume 57 – No. 2, pp. 14-20, November 2012.
[16] Megat Zuhairi, Haseeb Zafar and David Harle. The Impact of Mobility Models on the Performance of Mobile Ad Hoc Network Routing Protocol. The Institution of Electronics and Telecommunication Engineers Technical Review, Volume 29, Issue 5, pp. 414-420, September- October 2012.
[17] Arindrajit Pal, Jyoti Prakash Singh and Paramartha Dutta. The Effect of Speed Variation on Different Traffic Patterns in Mobile Ad Hoc Network. www.sciencedirect.com. Procedia Technoloy 4, pp. 743 – 748. 2012.
[18] Jyoti Prakash Singh and Parmartha Dutta. The Temporal Effect of Mobility on Path Length in MANET. Springer Science+Business Media. International Journal of Wireless Inf Networks, DOI 10.1007/s10776-011-0613-z.
[19] Umang, B. V. R. Reddy and M. N. Hoda. Study of Mobility Management Schemes in Mobile Adhoc Networks. International Journal of Computer Applications, Volume 17 – No. 7, pp. 42-47, March 2011.
[20] Valentina Timcenko, Mirjana Stojanovic, Slavica Bostjancic Rakas. MANET Routing Protocols vs. Mobility Models: Performance Analysis and Comparison. Proceedings of the 9th WSEAS International Conference on APPLIED INFORMATICS AND COMMUNICATIONS (AIC '09), pp. 271-276.

[21] M. Sreerama Murthy and M. Venkat Das. Performance Evaluation of MANET Routing Protocols using Reference Point Group Mobility and Random Way Point Models. International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) Vol2, No.1, pp. 33-43, March 2011.

[22] Fahim Mann and Nauman Mazhar. MANET Routing Protocols vs Mobility Models: A Performance Evaluation. IEEE 978-1-4577-1177-0/11, pp.179-184, 2011.

[23] Sabina Barakovic, Suad Kasapovic and Jasmina Barakovic. Comparison of MANET Routing Protocols in Different Traffic and Mobility Models. Telfor Journal, Vol2, No. 1, 2010.

[24] M. K. Jeya Kumar and R. S. Rajesh. Performance Analysis of MANET Routing Protocols in Different Mobility Models. IJCSNS International Journal of Computer Science and Network Security, Vol. 9, No. 2, February 2009.

[25] C. P. Agrawal, O. P. Vyas and M. K. Tiwari. Evaluation of Varying Mobility Models & Network Loads on DSDV Protocol of MANETs. International Journal on Computer Science and Engineering, Vol. 1(2), pp. 40-46, 2009.

