EFFECT OF MOBILITY MODELS ON THE PERFORMANCE OF MULTIPATH ROUTING PROTOCOL IN MANET

Indrani Das[1] , D.K Lobiyal[2] and C.P Katti[3]

[1,2,3]School of Computer and Systems Sciences
Jawaharlal Nehru University, New Delhi, India.
[1]indranidas2000@gmail.com, [2]lobiyal@gmail.com,[3]cpkatti@yahoo.com

ABSRACT

In this paper, we have analyzed the performance of multipath routing protocol with various mobility models for Mobile Ad Hoc Networks. The basic purpose of any multipath routing protocol is to overcome various problems occurs while data delivery through a single path routing protocol. For high acceptability of routing protocol, analysis of routing protocol in ad hoc network only with random way point mobility model is not sufficient. Here, we have considered Random waypoint, Random Direction and Probabilistic Random Walk mobility Model for proper analysis of AOMDV routing protocol. Results obtained show that with increasing node density, packet delivery ratio increases but with increasing node mobility Packet delivery ratio decreases.

KEYWORDS

AOMDV, Multipath Routing, Ad hoc Network, Packet delivery ratio, Mobility models.

1. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a network where more than two autonomous mobile hosts (mobile devices i.e. mobile phone, laptop, iPod, PDAs etc) can communicate without any mean of infrastructure i.e. on the fly. When source (*S*) node want to send some data toward the destination (*D*), if they are in the same transmission range can directly communicate with each other otherwise intermediate nodes help to relay data from source to destination. In MANETs individual node can leave and join the network on its own, therefore the physical structure of the network frequently changes dynamically. Battery power of mobile device is also important aspect, because depletion of battery power may affect the lifetime of a node . Node movements differ for mobile nodes are different, the topology also depend on the speed and direction of nodes. Due to dynamic topology of the network routing in MANET is a challenging issue. Single path routing is not always sufficient to disseminate data to the destination. Therefore; multipath routing comes into existence to overcome the problem of single path routing.

In this paper we have considered various mobility models for proper and in depth analysis of AOMDV protocol. In literature we have discussed various works related to AOMDV protocol and brief about various multipath routing protocols. Most of the work carried out based on random waypoint mobility model. So we tried to analyze AOMDV protocol with various network parameters and mobility models.

Dhinaharan Nagamalai et al. (Eds) : ACITY, WiMoN, CSIA, AIAA, DPPR, NECO, InWeS - 2014
pp. 149–155, 2014. © CS & IT-CSCP 2014 DOI : 10.5121/csit.2014.4516

The rest of the paper is organized as follows. In section II we have discussed various works related to multipath routing. In section III, various mobility models and AOMDV routing protocol briefly discussed. Results analysis and simulation work is presented in Section IV and finally, we have concluded the paper in Section V.

2. RELATED WORKS

Multipath routing overcomes various problems occurs while data delivered through a single path. The multipath routing protocols are broadly classified based on on-demand, table driven, and hybrid. The following multipath routing protocols are used in MANETs. In [1] authors have compared the performance of AOMDV and OLSR routing protocol with Levy-Walk and Gauss-Markov Mobility Model. For the analysis they have considered varying mobility speed and the traffic load in the network. Their results show that AOMDV protocol achieved higher packet delivery ratio and throughput compared to OLSR. Further, OLSR has less delay and routing overhead at varying node density. In [2] authors only compared AOMDV and AODV routing protocol with random way point mobility model. Different traffic source like TCP and CBR is considered. The result shows that with increasing traffic both routing protocols performance degraded. In M-DSR (Multipath Dynamic Source Routing) [5, 21] is an on demand routing protocol based on DSR [12] is a multipath extension of DSR. In SMR (Split Multipath Routing) [5, 15] is an on demand routing protocol and extension of well- known DSR protocol. The main aim of this protocol is to split the traffic into multiple paths so that bandwidth utilization goes in an efficient manner. In GMR (Graph based Multipath Routing) [5, 9] protocol based on DSR, a destination node compute disjoint path in the network using network topology graph. In MP-DSR [5, 13, 16] is based on DSR; it is design to improve QoS support with respect to end-to-end delay. In [10,19] authors have proposed an on-demand multipath routing protocol AODV-BR. But to establish multipath it does not spend extra control message. This protocol utilizes mesh structure to provide multiple alternate paths. In [8] authors have considered node-disjoint and link-disjoint multi-path routing protocol for their analysis. The various mobility model considered are Random Waypoint, Random Direction, Gauss-Markov, City Section and Manhattan mobility models. Through the thorough analysis they have shown that in Gauss markov mobility model multipath formation is less but path stability is high. The random direction model form larger number of multipath. In [14] authors have considered AODV and AOMDV protocol for their performance analysis with random waypoint model. The result shows that AOMDV has more routing overhead and average end to end delay compared to AODV. But AOMDV perform better in term of packets drops and packet delivery. In [17] various energy models with Random Waypoint Mobility Model-Steady State mobility model is used to analyze the energy overhead AOMDV, TORA and OLSR routing protocols. Results show that TORA protocol has highest energy overhead in all the energy models.

3. DESCRIPTION OF ROUTING PROTOCOL AND MOBILITY MODELS

In this section we have discussed brief about AOMDV routing protocol and various mobility models considered for simulation work.

3.1 Ad Hoc On Demand Multipath Distance Vector (AOMDV)

Ad Hoc On Demand Multipath Distance Vector (AOMDV) [3, 5, 6, 11] protocol is a multipath variation of AODV protocol. The main objective is to achieve efficient fault tolerance i.e. quickly recovery from route failure. The protocol computes multiple link disjoint loop free paths per route discovery. If one path fails the protocol choose alternate route from other available paths. The route discovery process is initiated only when to a particular destination fails. When a source needs a route to destination will floods the RREQ for the destination and at the intermediate nodes all duplicate RREQ are examined and each RREQ packet define an alternate route. However, only link disjoint routes are selected (node disjoint routes are also link disjoint). The destination node replies only k copies of out of many link disjoint path, i.e. RREQ packets arrive through unique neighbors, apart from the first hop are replied. Further, to avoid loop 'advertised hop count' is used in the routing table of node .The protocol only accepts alternate route with hop count less than the advertised hop count. A node can receive a routing update via a RREQ or RREP packet either forming or updating a forward or reverse path .Such routing updates received via RREQ and RREP as routing advertisement.

3.2 Mobility Models

Mobility pattern of node plays a vital role in evaluation of any routing protocol in MANET. We have considered various categories mobility models for acceptability of routing protocol. The following mobility model we have considered in simulation work.

3.2.1 Random Waypoint Model

The Random Waypoint (RWP) mobility model [4,7] is the only model which is used in maximum cases for evaluation of MANET routing protocols. In this model nodes movement depends on mobility speed, and pause time. Nodes are moving in a plane and choose a new destination according to their speed. Pause time indicate that a node to wait in a position before moved to new position.

3.2.2 Probabilistic Random Walk Model

In this model [4,7] nodes next position is determined by set of probabilities. A node can be move forward, backward or remain in x and y direction depends on the probability defined in probability matrix. There are three state of node is defined by 0 (current position), 1 (previous position) and 2 (next position). Where, in the matrix P (a,b) means the probability that an node will move from state a to state b.

3.2.3 Random Direction Model

The random direction model [4,7] is the further modification of Random waypoint mobility model. This model overcome the density wave problem occur in random waypoint model, where clustering of nodes occur in a particular area of simulation. In Random Waypoint model this density occurs in the center of the simulation area. Here, nodes are move upto the boundary of the simulation area before moving to a new location with new speed and direction. When nodes are reached to the boundary of simulation area, before changing to new position it pauses there for sometimes. The random direction it chooses from 0 to 180 degrees. The same process is continued till the simulation time.

4. Simulation Setup And Result Analysis

For the simulation works we have used Bonn-Motion mobility generator [18] to generate the mobility of nodes based of various mobility models. The most popular network simulator NS-2.34 [20] is used to simulation work. Finally, Matlab [22] is used to compute the results. In table-1 and table-2 shows different simulation parameters and their values respectively. We have computed packet delivery ratio as a parameter to analyze the performance of AOMDV protocol.

Table 1. Simulation Parameters

Parameter	Specifications
MAC Protocol	IEEE 802.11 DCF
Routing Protocol	AOMDV
Radio Propagation Model	Two-ray ground reflection model
Channel type	Wireless channel
Antenna model	Omni-directional
Mobility Models	Random waypoint, Random Direction, Probabilistic Random Walk

Table 2. Values of Simulation Parameters

	Values
Simulation Time	1000s
Simulation Area (X *Y)	1000 m x1000 m
Transmission Range	250 m
Bandwidth	2 Mbps
No. of Nodes	10,20,30,40,50,100
Node speed	10,20,30 m/s

Fig.1 shows the packet delivery ratio at node mobility 10 m/s in various mobility models. In Probabilistic Randomwalk model AOMDV gives better packet delivery ratio with increasing node density. In Random direction model AOMDV protocol perform better at node density 70 onwards. Except Probabilistic Random walk model in rest of the model PDR value decreases in high node density. The highest PDR value achieved 77.8.

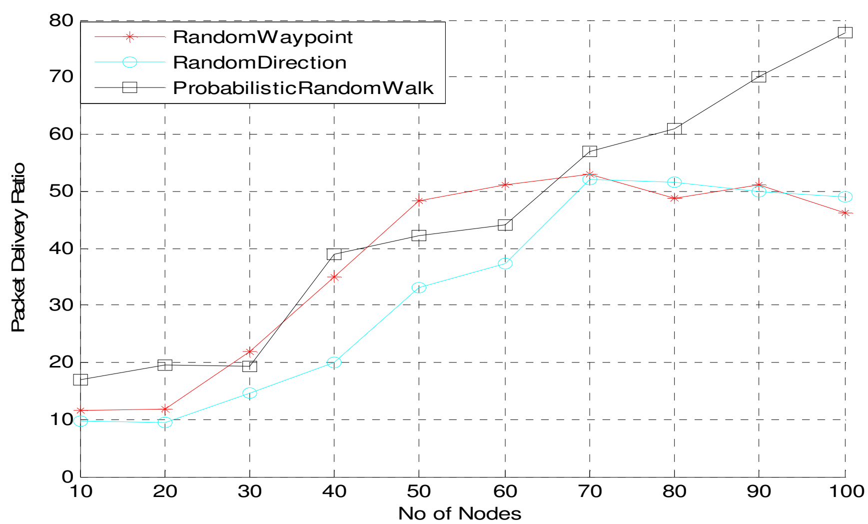

Figure 1. Packet delivery ratio with node speed at 10m/s.

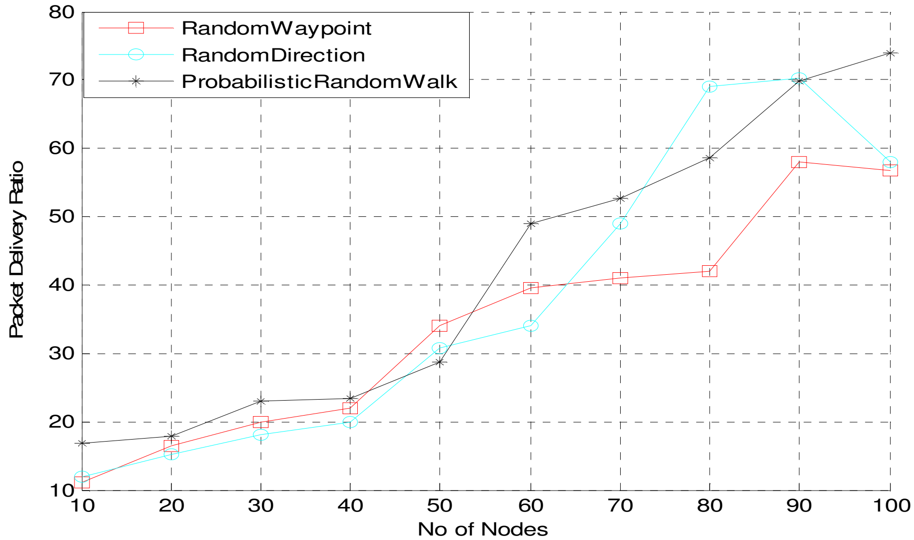

Figure 2. Packet delivery ratio with node speed at 20m/s.

Fig.2 shows the packet delivery ratio at node mobility 20 m/s in various mobility models. In this scenario up to node density 50 protocol perform quite same, but there is slight improvement is noticed in all the models till node 90. After node density 90 only in probabilistic random model protocol perform better.

Fig.3 shows the packet delivery ratio at node mobility 30 m/s in various mobility models. In Probabilistic Randomwalk model AOMDV gives better packet delivery ratio after node density 80. The protocol perform better in Randomway point model as compare to others till node density 40, but after that slight decrease in noticed in PDR values till node density 60 in Randomway point model. In node density 40 to 70 the protocol performs better with random direction model.

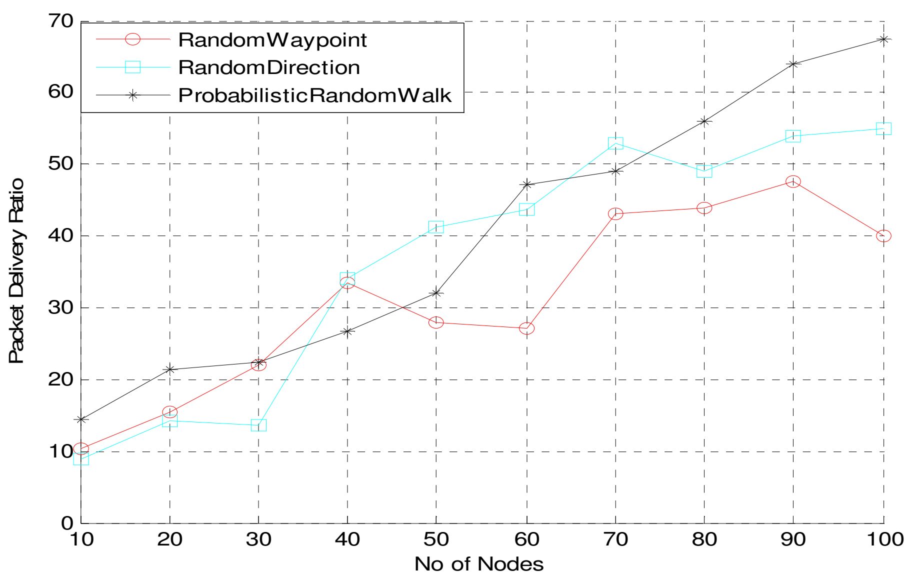

Figure 3. Packet delivery ratio with node speed at 30m/s.

The results show that with high node mobility in all models PDR value decreases. When node density is 100, PDR value decreases almost 13% is noticed in probabilistic Random walk and Randomway point model. But in random direction model increase of 12% in PDR value noticed.

5. CONCLUSIONS

We have evaluated the performance of multipath routing protocol with different mobility models. We have generated various node movements with varying node speed and number node based on mobility models. For analysis the performance of the protocol packet delivery ratio is computed. It is evident from the results that AOMDV protocol perform better in term of PDR in Probabilistic Randomwalk model in low node mobility, and for higher node mobility except random direction model in other models PDR decreases. In future, this multipath protocol can be investigated with various other network topologies.

REFERENCES

[1] Gowrishankar. S, et al. (2010) “Analysis of AOMDV and OLSR Routing Protocols under Levy-Walk Mobility Model and Gauss-Markov Mobility Model for Ad Hoc Networks”, (IJCSE) In-ternational Journal on Computer Science and Engineering, Vol. 02, No. 04, 2010, pp. 979-986.

[2] Vivek B. Kute et al., (2013) “Analysis of Quality of Service for the AOMDV Routing Protocol”, ETASR - Engineering, Technology & Applied Science Research Vol. 3,No. 1, pp.359-362.

[3] Jiazi Yi , AsmaaAdnane, Sylvain David, and Benoît Parrein, (2011) “Multipath optimized link state routing for mobile ad hoc networks”, Ad Hoc Networks, Vol. 9, No.1, pp. 28-47 .

[4] Radhika Ranjan Roy, (2011) Handbook of Mobile Ad Hoc Networks for Mobility Models, First Edition, Springer, New York Dordrecht Heidelberg London, ISBN 978-1-4419-6048-1 e-ISBN 978-1-4419-6050-4.

[5] Tsai, J., & Moors, T., (2006) “A review of multipath routing protocols: from wireless ad hoc to mesh networks”, In Proceedings of ACoRN early career researcher workshop on wireless multi-hop networking, Sydney.

[6] M. K. Marina and S. R. Das, (2006) “Ad-hoc on-demand multi-path distance vector routing”, Wireless Communication Mobile Computing, Vol. 6, No. 7, pp. 969–988.

[7] Camp, Tracy et al., (2002) “A Survey of Mobility Models for Ad Hoc Network Research”, wire-less communications & mobile computing (WCMC): special issue on mobile ad hoc networking: research, trends and applications, Vol.2, No.5, pp. 483-502.

[8] Nicholas cooper et al., (2010) “Impact of Mobility models on multipath routing in mobile Ad hoc Networks”, International Journal Of Computer Networks & Communications (IJCNC), Vol. 2, No.1, pp.185-194.

[9] Gunyoung Koh, Duyoung Oh and Heekyoung Woo, (2003) “A graph-based approach to com-pute multiple paths in mobile ad hoc networks”, Lecture Notes in Computer Science Vol. 2713, Springer, pp. 3201–3205.

[10] M.T.Toussaint, (2003) “Multipath Routing in Mobile Ad Hoc Networks”, TU-Delft/TNO Traineeship Report.

[11] S. Das, C. Perkins and E. Royer, “Ad Hoc On Demand Distance Vector (AODV) Routing”, IETF RFC3561, July 2003.

[12] D. Johnson, (2003) “The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR)”, IETF Internet Draft, draft-ietf-manet-dsr-09.txt.

[13] E. Esmaeili, P. Akhlaghi, M. Dehghan, M.Fathi,(2006) “A New Multi-Path Routing Algorithm with Local Recovery Capability in Mobile Ad hoc Networks”, In the Proceeding of 5th Interna-tional Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP 2006), Patras, Greece, pp. 106-110.

[14] R.Balakrishna et al., (2010) “Performance issues on AODV and AOMDV for MANETS”, International Journal of Computer Science and Information Technologies, Vol. 1, Issue.2, pp. 38-43.

[15] S. J. Lee and M. Gerla, (2001) “Split Multipath Routing with Maximally Disjoint Paths in Ad Hoc Networks”, In Proceedings of the IEEE ICC, pp. 3201-3205.

[16] R. Leung, J. Liu, E. Poon, Ah-Lot. Chan, B. Li, (2001) "MP-DSR: A QoS-Aware Multi-Path Dynamic Source Routing Protocol for Wireless Ad-Hoc Networks", In Proc. of 26th Annual IEEE Conference on Local Computer Networks (LCN), pp. 132-141.
[17] Gowrishankar.S et al., (2010) "Simulation Based Overhead Analysis of AOMDV, TORA and OLSR in MANET Using Various Energy Models", Proceedings of the World Congress on Engi-neering and Computer Science,San Francisco, USA, Vol.1.
[18] Bonn Motion, http://net.cs.uni-bonn.de/wg/cs/applications/bonnmotion/
[19] Sung-Ju Lee and Mario Gerla, (2000) "AODV-BR: Backup Routing in Ad hoc Networks", IEEE Conference on Wireless Communications and Networking Conference (WCNC- 2000),Vol.3, PP. 1311-1316 .
[20] The Network Simulator. http://www.isi.edu/nsnam/ns/.
[21] A. Nasipuri and S. R. Das, (1999)"On-demand multipath routing for mobile ad hoc networks", In the Proceedings of Eight International Conference on Computer Communications and Net-works, Boston, MA, .
[22] The Math Works: http://www.mathworks.com

AUTHORS

Indrani Das did her B. E. and M.Tech in Computer Science. She is working as Assistant Professor in Computer Science depart-ment in Assam University (A Central University), Assam, India. Presently, she is perusing her Ph.D from School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi, In-dia. Her current research interest includes Mobile Ad hoc Net-works and Vehicular Ad hoc Networks.

Daya K. Lobiyal Received his Bachelor of Technology in Com-puter Science from Lucknow University, India, in 1988 and his Master of Technology and Ph.D both in Computer Science from Jawaharlal Nehru University, New Delhi, India, 1991 and 1996, respectively. Presently, he is an Associate Professor in the School of Computer and Systems Sciences, Jawaharlal Nehru University, India. His areas of research interest are Mobile Ad hoc Networks, Vehicular Ad Hoc Networks, Wireless Sensor Network and Vid-eo on Demand.

C. P. Katti is a professor of computer science at Jawaharlal Nehru University. He received his Ph.D from IIT Delhi. He has published over 30 papers in journals of international repute. His area of research includes parallel computing, ad hoc networks and numerical analysis.