Simulation Study Analysis of Destination Sequenced Distance Vector Protocol for (Freeway and Random Wayward) Mobility Models

*Samera Hamad Mahmud

Abstract: A Mobile Ad-Hoc Network (MANET) is a self-configuring network of mobile nodes connected by wireless links to form an arbitrary topology without the use of existing infrastructure. In this paper, I have studied the effects of various mobility models on the performance of one routing Destination Sequenced Distance Vector (DSDV Proactive Protocol). I have considered two mobility scenarios for experiment purposes: (Random Wayward and Freeway) Mobility models. This study aims to determine which appropriate speed is suitable with DSDV protocol when I applied it on (Random Wayward and Freeway) Mobility models, with different speeds. Experiment results illustrate that the performance of the routing protocol varies across different mobility models and different speeds on the mobile node.

Keywords: Mobile Ad-Hoc Network (MANET) , Destination Sequenced Distance Vector (DSDV**).**

Introduction:

A Mobile Ad-Hoc Network (MANET) is a self-configuring network of mobile nodes connected by wireless links, to form an arbitrary topology. The nodes are free to move randomly. Thus the network's wireless topology may be unpredictable and change rapidly. Minimal configuration, quick deployment, and absence of a central governing authority make ad hoc networks suitable for emergencies like natural disasters, military conflicts, emergency medical situations, etc [1] [2]. Many previous studies have used Random Wayward Mobility as a reference model [3] [4]. However, in the future, MANETs are expected to be used in various applications with diverse topography and node configuration. The overall performance of any wireless protocol depends on the duration of interconnections between any two nodes transferring data as well as the duration of interconnections between nodes of a data path containing n-nodes. I will call these parameters averaged over an entire network as “Average Connected Paths”.

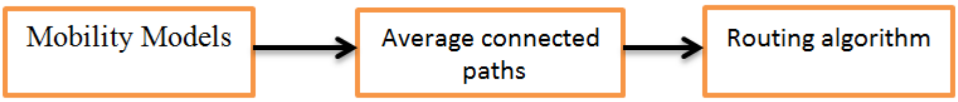

Figure 1. Relationship between protocol performance and mobility model.

The mobility of the nodes affects the number of average connected paths, which in turn affects the performance of the routing algorithm. I have also studied the impact of node density on routing performance. With a very sparsely populated network, the number of the possible connection between any two nodes is very less and hence the performance is poor. It is expected that if the node density is increased the throughput of the network shall increase, but beyond a certain level of density is increased the performance degrades in some protocol. I have also studied the effect of several hops on the protocol performance [5] [6] [7] [8].

Destination-Sequenced Distance-Vector (DSDV):

Destination-Sequenced Distance-Vector Routing protocol is a proactive table-driven algorithm based on classic Bellman-Ford routing. In proactive protocols, all nodes learn the network topology before a forward request comes in. In DSDV protocol each node maintains

* **Computer Department, Omar Al-Mukhtar University, Libya**
samera.hamad@omu.edu.ly

routing information for all known destinations. The routing information is updated periodically. Each node maintains a table, which contains information for all available destinations, the next node to reach the destination, the number of hops to reach the destination, and the sequence number. The nodes periodically send this table to all neighbors to maintain the topology, which adds to the network overhead. Each entry in the routing table is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops [9].

Description of Mobility Models:

Different mobility models can be differentiated according to their spatial and temporal dependencies. Spatial dependency: It is a measure of how two nodes are dependent on their motion. If two nodes are moving in the same direction then they have a high spatial dependency. Temporal dependency: It is a measure of how current velocity (magnitude and direction) are related to the previous velocity. Nodes having the same velocity have high temporal dependency[10].

1. Random Wayward Mobility

The Random Wayward Mobility model is the most commonly used in the research community. At every instant, a node randomly chooses a destination and moves towards it with a velocity chosen randomly from a uniform distribution [0, V_max], where V_max is the maximum allowable velocity for every mobile node. After reaching the destination, the node stops for a duration defined by the 'pause time' parameter. After this duration, it again chooses a random destination and repeats the whole process until the simulation ends. Figure 2 illustrates an example of a topography showing the movement of nodes for the Random Wayward Mobility Model [10].

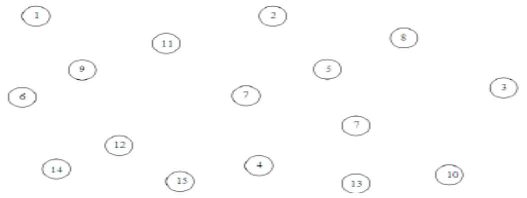

Figure 2. Topography showing the movement of nodes for Random Wayward Mobility model

2. Freeway Mobility Model

This model emulates the motion behavior of mobile nodes on a freeway. It can be used in exchanging traffic status or tracking a vehicle on a freeway. Each mobile node is restricted to its lane on the freeway. The velocity of the mobile node is temporally dependent on its previous velocity. Figure 3 is an example topography showing the movement of nodes for the Freeway Mobility Model with twelve nodes[10].

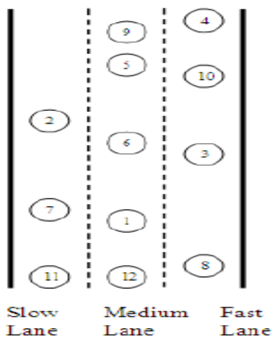

Figure 3. Topography showing the movement of nodes for Freeway mobility model

Important Characteristics: In this model I use maps. There are several freeways on the map and each freeway has lanes in both directions. The differences between Random Wayward and Freeway Mobility are the following:

(a) Each mobile node is restricted to its lane on the freeway.

(b) The velocity of the mobile node is temporally dependent on its previous velocity. Formally,

$$|V_i(t+1)| = |V_i(t)| + random() * |a_i(t)|$$

(c) If two mobile nodes on the same freeway lane are within the Safety Distance (SD), the velocity of the following node cannot exceed the velocity of the preceding node. Formally,

$$\forall i, \forall j, \forall t, D_{ij}(t) < SD \Rightarrow |V_i(t)| < |V_j(t)|$$

if j is ahead of i in its lane.

Due to the above relationships, the Freeway mobility pattern is expected to have high spatial dependence and high temporal dependence. It also imposes strict geographic restrictions on the node movement by not allowing a node to change its lane.

The objective of this study:

To analyze the impact of which speed is suitable with DSDV routing protocol to get the better throughput to depend on Random Wayward and Freeway mobility models.

Related Work:

Mobile ad hoc networks and routing protocols have been examined and studied broadly by different researchers in the recent past and have added great information to a large extent in the existing mine of comprehension as well as found some new openings in this area. Some of the appreciable researches in this regard are given below. I have studied the effect of several hops on protocol performance [5] [6] [7] [8]. For quick response and maximum reachability, especially in small ad-hoc networks, flooding is still the technique for information dissemination [11] since the performance of Wang and Li [12, 13] does not measure well when the nodes exhibit significant mobility and random movement. Williams and Camp [14] provide a comprehensive analysis of different flooding techniques proposed so far in ad-hoc networks. The models are tested by speed as the main parameter in scenarios[15]. The model was tested by the Throughput performance of DSDV for different mobility models for varying speeds [16][17].

Simulation Scenario for Different Speed in Mobility Models:

1) I have compared the Throughput performance of DSDV for different mobility models namely (Random Wayward and Freeway) in terms of data rate (bytes per second) for varying speeds.

2)Throughput = No. Of Packets received (bytes) / Simulation time (second).

3) The routing protocol used for the simulation is available with NS-2 [18].

4) Standard 802.11 MAC layer was used and the transmission range in each simulation was 250 meters. All the nodes in the simulation had omnidirectional antennas. Standard CMUPri model for the queue of buffer size 50 was used. The simulation had 40 nodes and is run for 500 seconds. I created two scenarios:

5) Flat 1000x1000 meter scenario was created in the Wayward model.

6) Flat 20000x2000 meter scenario was created in Freeway Model.

No motion in z-direction was allowed thus the whole topology was two dimensional. Trace generated was User Datagram Protocol (UDP) type trace.

For two mobility models, I have varied the maximum allowed velocity (Vmax) and obtained averaged. In Random Wayward mobility is defined as Vmax. Thus scenario having higher Vmax is highly mobile. To calculate the performance, 10 data connections are monitored.

In the Freeway mobility model the mobility is defined as the maximum allowed velocity of the medium lane and fast and slow lane velocity +10 meter/sec and -10 meter/sec of medium lane velocity. Thus increasing the velocity of the middle lane the velocity of the whole scenario can be increased. Initially, all the nodes were distributed randomly in all three lanes. To calculate the performance, 10 data connections are monitored.

Results and Discussions:

Figure 4 and Figure 5 show the results of simulations, In the two mobility models, I have increased the mobility and recorded the performance. I did this simulation for 500 seconds with 10 UDP connections.

Readings were taken for different mobility (Max speed 10, 20, 30, 40 meters/sec). The total throughput of the system was averaged.

From the results, it is evident that as the mobility increases; the performance of DSDV deteriorates.

But in the two cases, the freeway mobility model better than the Random Wayward mobility model see in Figure 6.

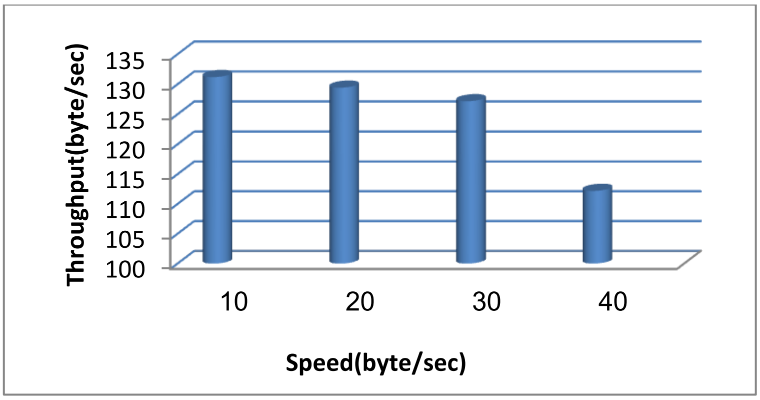

Figure 4. Throughput in Freeway Mobility Model.

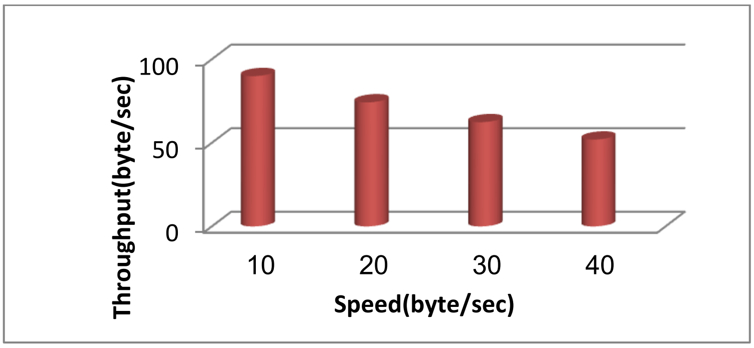

Figure 5. Throughput in Random Wayward Mobility Model.

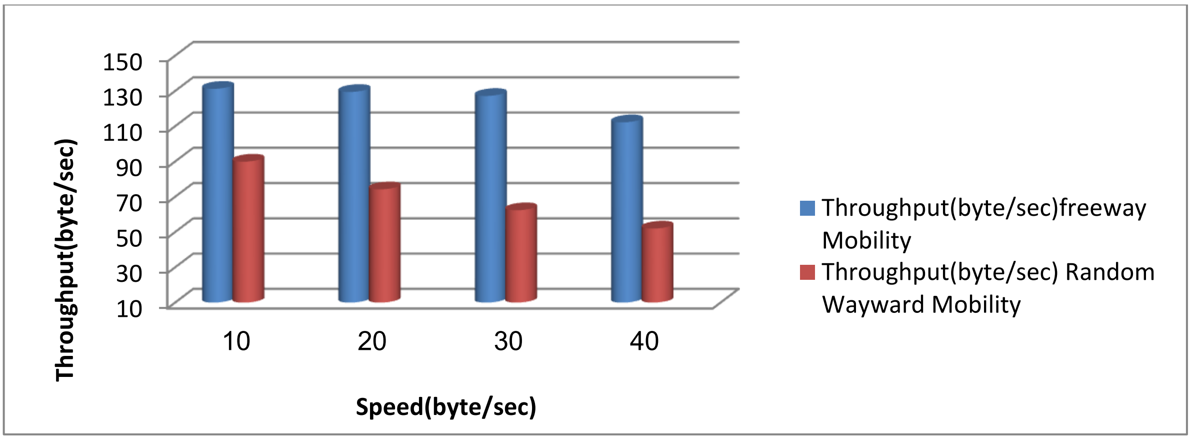

Figure 6. Compare Throughput between (Random Wayward and Freeway) Mobility Models

Conclusion:

In this study, empirical results illustrate that the performance of a routing protocol varies widely across different speeds on the mobile node, it's better for slow motion in the mobility model. in DSDV there is no route repair mechanism. In DSDV, if no route is found to the destination, the packets are dropped.

Future work:

For future work, I am planning to study the effects of various mobility models on the performance of two routing protocols Dynamic Source Routing (DSR-Reactive Protocol) and Destination-Sequenced Distance-Vector (DSDV-Proactive Protocol). Designing scenarios that depict real-world applications more accurately can be designed through a depth study of the application.

دراسة محاكاة تحليل بروتوكول DSDV لنموذجي التنقل (Random Wayward and Freeway)

المستخلص : شبكة (**MANET**) Mobile Ad-Hoc Network : عبارة عن شبكة ذاتية التكوين من عقد الهاتف المحمول المتصلة بواسطة ارتباطات لاسلكية لتشكيل هيكل عشوائي دون استخدام البنية التحتية الحالية.

في هذه الورقة ، قمت بدراسة تأثيرات نماذج التنقل المختلفة على أداء متجه مسافة متسلسلة لوجهة توجيه واحدة (بروتوكول DSDV).لغرض التجربة ، لقد فكرت في نموذجين من نماذج التنقل هما : (Random Wayward and Freeway).

تهدف هذه الدراسة إلى تحديد السرعة المناسبة مع بروتوكول DSDV عندما قمت بتطبيقه على نموذجي التنقل (Random Wayward and Freeway) بسرعات مختلفة.

توضح نتائج التجربة أن أداء بروتوكول التوجيه يختلف باختلاف نماذج التنقل والسرعات المختلفة على العقدة المتنقلة.

References

[1] S. Corson and J. Macker, Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations, RFC: 2501, January 1999. http://www.ietf.org/rfc/rfc2501.txt

[2] Muhammad Mahmudul Islam, Ronald Pose, Carlo Kopp - Suburban Ad-hoc Networks in Information Warfare - 6th Australian InfoWar Conference, Geelong, Australia, 24-25 November 2005.

[3] Guolong Lin, Guevara Noubir and Rajmohan Rajaraman, "Mobility Models for Ad hoc Network Simulation", INFOCOM 2004.

[4] Tracy Camp, Jeff Boleng and Vanessa Davies, “A Survey of Mobility Models for Ad Hoc Network” Wireless Communication & Mobile Computing (WCMC): Special issue on Mobile Ad Hoc Networking: Research, Trends and Applications, vol. 2, no. 5, pp. 483-502, 2002.

[5] Fan Bai, Narayanan Sadagopan and Ahmed Helmy, The IMPORTANT framework for analyzing the Impact of Mobility on Performance Of RouTing protocols for Adhoc NeTworks, Ad Hoc Networks,Volume 1, Issue 4, pp. 383-403, 2003.

[6] F. Bai, A. Helmy, "A Survey of Mobility Modeling and Analysis, Wireless Adhoc and Sensor Networks, Book Chapter, Kluwer Academic Publishers, April 2003.

[7] F. Bai, G. Bhaskara and A. Helmy," Building the Blocks of Protocol Design and Analysis – Challenges and Lessons Learned from Case Studies on Mobile Adhoc Routing and Micro-Mobility Protocols", ACM Computer Communication Review, Vol.34, No.3, pp.57-70, July 2004.

[8] F. Bai, N. Sadagopan and A. Helmy, "IMPORTANT: A framework to systematically analyze the Impact of Mobility on Performance of Routing protocols for Adhoc Networks", IEEE INFOCOM, pp.825-835, March/April 2003.

[9] Charles E Perkins and Pravin Bhagwat, “Highly Dynamic Destination Sequenced Distance Vector Routing (DSDV) for Mobile Computers, SIGCOMM 94, pp. 234-244, 1994.

[10] D .Bhavyesh, A .Ajith, G. Crina and S .Sugata , Analysis of Dynamic Source Routing and Destination Sequenced DistanceVector Protocols for Different Mobility models, 10.1109 ,Conference Paper · March 2007.

[11]V. D. Park and M. Scott Corson. A highly adaptive distributed routing algorithm for mobile wireless networks. In INFOCOM (3), pages 1405–1413, 1997.

[12] Baochun Li, “QoS-aware Adaptive Services in Mobile Ad-hoc Networks,” in Proceedings of the Ninth IEEE International Workshop on Quality of Service (IWQoS 01), also Lecture Notes in Computer Science, ACM Springer-Verlag, Vol. 2092, pp. 251-268, Karlsruhe, Germany, June 6-8, 2001.

[13] K. Wang, B. Li, “Group Mobility and Partition Prediction in Wireless Ad-hoc Networks ,” in Proceedings of IEEE International Conference on Communications (ICC 2002), New York City, New York, April 28 - May 2, 2002.

[14] B.Williams and T. Camp, “Comparison of broadcasting techniques for mobile ad hoc networks,” in Proceedings of the ACM International Symposium on Mobile Ad Hoc Networking and Computing (MOBIHOC), pages 194-205, 2002.

[15] K .Mahmood, M. Muhammad Faran, M .Amjad,S. Khalid and L. Jaime, " The Impact of Mobility Speed over Varying Radio Propagation Models using Routing Protocol in MANET ", Conference Paper, December 2020.

[16]Anne Aaron and Jie Weng, Performance Comparison of Ad-hoc Routing Protocols for Networks with Node Energy Constraints, Online report: http://www.stanford.edu/~amaaron/ee360/EE360_FIN AL_PAPER.pdf, 2001.

[17] E.Gnanamanoharan, R.Bensraj, PERFORMANCE ANALYSIS OF PROBABILISTIC BROADCAST ON DEMAND ROUTE DISCOVERY PROTOCOL FOR MOBILE AD HOC NETWORKS BASED ON NODE MOBILITY, *GNANAMANOHARAN ET ,174-178*/ March*.,2019.*

[18]User Manual for IMPORTANT Mobility Tool Generator in NS-Simulator.http://nile.usc.edu/important/software.htm, Release date February 2004.