VOL. 10, NO. 8, MAY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences
©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.
www.arpnjournals.com

IMPACT OF MOBILITY SPEED ON PROACTIVE AND REACTIVE ROUTING PROTOCOLS IN MOBILE ADHOC NETWORKS

E. Gnanamanoharan and R. Bensraj
Department of Electrical Engineering, Annamalai University, Tamil Nadu, India
E-Mail: gnanamanohar@gmail.com

ABSTRACT

A Mobile Ad-Hoc Network (MANET) is an autonomous system and mobile nodes can communicate with each other by wireless links. At any moment nodes are coming together and leaving the network in random manner and also fast moving nodes frequently. These nodes get connected to each other and also can act as a router, by forward data to other wireless nodes. The topology of the network changes often or quickly by mobility of the nodes is an important aspect in the design of effective routing algorithm and it should be efficient and consistent to discover new routes and maintain them till the successful delivery of packets between the node pairs. This paper systematically discuses the performance evaluation and comparison of three routing protocols AODV, DSR and DSDV in two different scenarios using random waypoint mobility model and performance metrics such as throughput, packet delivery ratio and end-to-end delay are considered for the significant impact of mobility speed on the performance of the both proactive and reactive routing protocols.

Keywords: mobility models, AODV, DSR, DSDV, NS2, MANET's, RWP.

1. INTRODUCTION

In MANET's, mobile nodes form unpredictable topology may be change quickly and the variation in the node mobility are expected to have a significant impact on the performance of the both proactive and reactive routing protocols. Node mobility speed affects the number of average connected path and mobility of mobile nodes may lead to breakup of communication links also the performance of the network depends on time duration of link between node pair. Node mobility is one of the inherent characteristics in wireless networks. Mobility models play a significant role and are used for analyzing the performance metrics [1] of entire network. The simulation model with a constant network size and a varying pause times or mobility velocities and these works do not take into account the influence on the protocols with variation of network size. Many previous studies have used Random Waypoint as reference model [3] and [4]. The statistical behavior of physical motion of mobile nodes are described by different mobility models are provided a good survey of the most frequently used mobility models is presented in [2]. The performance evaluations are carried out for the five kinds of routing protocols WRP, FSR, DSR, LAR and DREAM in [5]. The radio propagation range for each node is 200 m fixed and channel capacity is 2 M bit/s. A network simulation model consist of 60 mobile hosts and varying pause times, the latter modeled sceneries with 50 nodes and pause time of 0, 30, 60, 120, 300, 600 and 900 s, respectively for both AODV and DSR in [6 ,8, 9]. The performance evaluation and detailed comparison of four routing protocols AODV, DSDV, DSR and TORA is presented [10, 11, 12]. The metrics are suggested by the MANET working group for routing protocol evaluation are average throughput, average end-to-end delay, packet loss and packet delivery ratio [1] and we computed these metrics to evaluate the performance of AODV, DSR and DSDV protocols.

2. PROACTIVE AND REACTIVE ROUTING PROTOCOL

Numbers of routing protocols have been developed for ad hoc mobile networks. Such protocols must deal with characteristic limitations of the wireless networks. Reactive routing protocols that initiate routing activities when requiring route between node pairs in ad hoc networks [10, 12]. AODV executes route discovery using route request (RREQ) and route reply (RREP) control packets whenever node needs to send packet to destination and add the id of intermediate nodes in its route Table with a lifetime association using RREP. If the destination or intermediate node moves to new location, a route error (RERR) is sent to the sender. Once sender receives the RERR, it can reinitiate again route discovery if the route is still needed. Neighborhood information is incurred from periodic Hello packet. If there is link broken due to mobility speed, the AODV [11] is maintain timer-based routing Table at each node individually and entry is "expired" if not used recently. (RERR) is sent to the sender. Once sender receives the RERR, it can reinitiate again route discovery if the route is still needed. Neighborhood information is incurred from periodic Hello packet. If there is link broken due to mobility speed, the AODV [11] is maintain timer-based routing table at each node individually and entry is "expired" if not used recently. There is a well defined cooperation is between the neighbor to identify and address the link broken. If there are any link break, DSR sends RERR message to source for new route. DSR is a simple and efficient routing protocol designed for use in multi hop wireless ad hoc networks. Network is self-organizing and self-configuring when using DSR. When the nodes in an ad hoc network move and join the network while forwarding packets, all routing is automatically determined and maintained by DSR. It allows nodes to dynamically discover a source route across multiple network hops to any destination and avoiding the need for up-to-date routing information in the

©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.

intermediate nodes. The overhead incurred by performing a new route discovery can be avoided when the caching of multiple routes to a destination occurs. DSDV is a proactive distance-vector protocol based on Bellman-Ford routing. All nodes study the network topology before sending RREQ and each node maintains routing table contain number of hops to reach the destination and sequence number for all possible routes and updated periodically. Each nodes periodically send this table to all neighbors, which adds to the network overhead. Each entry in the routing table is marked with a sequence number assigned by the receiving node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops.

3. MOBILITY MODELS

Mobility model perform an important role in the performance of a routing protocol concerned and currently, there are several mobility models available are Random Way Point, Manhattan Grid (MGM), Reference Point Group Mobility Model (RPGM) [2] etc. Figure-1 show the graphical representation of a node random moment is characterized by random way point mobility model.

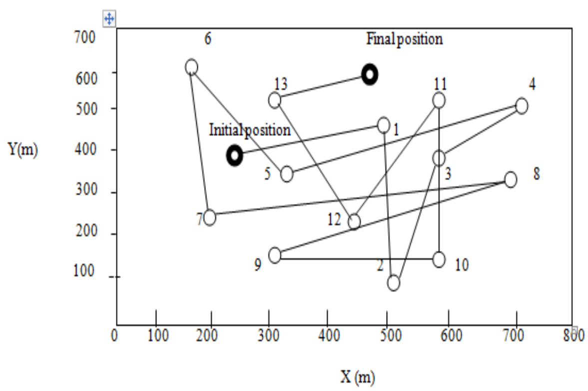

Figure-1. Moment pattern of a node applying random way point mobility model.

The mobility of nodes in MANET into two categories; one is entity mobility model and another is group mobility model [2]. Entity mobility is designed to simulate the movement of each individual. The most popular entity mobility model are Random Walk Mobility model and the Random Waypoint Mobility model for example car racing or gaming application. Group mobility model are designed to simulate the group movement. Reference Point Group Mobility Model [2], Reference region Group mobility model and Virtual Track Based Group Mobility Model, are some popular group mobility model. They are utilized in disaster recovery, battlefield, people visiting fair and search and rescue mission. The characteristic of these applications is that mobile nodes can be coordinated in the unit of groups. Freeway mobility tracking used for traffic mobility control in the highway and Manhattan Mobility Model tracking is relevant for the transport and control system in traffic city. The definitions and formulas for coverage area by node (Area covered by a node transmission is defined) and Foot print (Percentage of the simulation area covered by a node's transmission range) given by

Coverage area by node = π
Foot print A) / (X × Y) × 100

where X = length, Y = breadth of the topology (simulation area), r = transmission range. The two - way ground reflection model considers both the direct path and a ground reflection path. The model gives more accurate prediction at a long distance than the free space model [16]. The received power at distance d is predicted by

$$P_r\,(d) = P_t \;\; G_t \;\; G_r \;\; h_t^2 \;\; h_r^2 \,/\, d^4 \; L$$

where is the transmitted signal power and are the antenna gains of the transmitter, L (L >= 1) is the system loss and the receiver respectively and are the heights of the transmitting and receiving antennas respectively. It is common to select = = 1 and L = 1 in Ns - 2 based simulations.

4. SIMULATION METHODOLOGY

4.1 Traffic model

A traffic generator named cbrgen was developed to simulate constant bit rate sources in Ns-2 [13]. Each CBR package size is 512 bytes and one package is transmitted in 1 s and its popular traffic source in network simulation.

In this model, the data rate remains constant during the packet transmission. 50 mobile nodes are randomly deployed within an area of 700m x 500m and 1500 m x 1500 m simulation area. Radio propagation range for each node is 250 m and channel capacity is 2 mbps. 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. Figure-2 shows the simulated window consist of 50 nodes move according to random waypoint mobility model. 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.

The max movement speeds are 10m/s, 20m/s, 30m/s and 40m/s maximum at different movement patters and collected data is the averaged over those 10 runs. The most commonly used mobility model is RWP in research community.

VOL. 10, NO. 8, MAY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences
©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.
www.arpnjournals.com

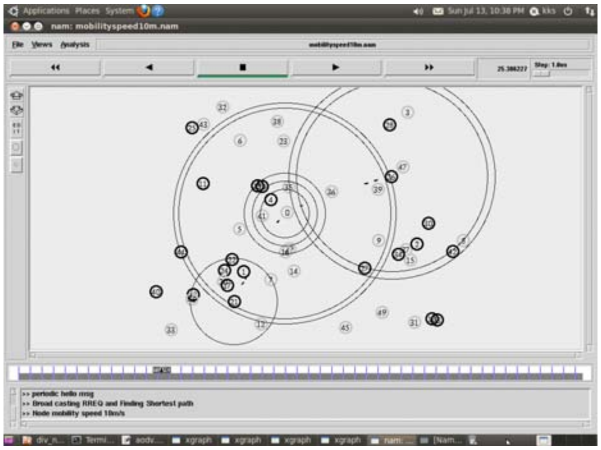

Figure-2. MANET setup and packet transmission

The Random Waypoint Model (RWP) is used as a representative of a mobility model where the motions of the nodes show little structure. With the RWP model, the nodes start at random, uniformly distributed positions spread over the whole area under simulation.

4.2 Scenario generation

The investigation of different RPs outcome within MANETs for different simulation area and node moment and connection pattern has been carried out through these two scenarios.

Scenario 1: In this scenario, the simulation area is 700 m x 500m chosen and the transmission range is fixed for each node is 250 m and nodes are being displaced randomly at various location within the simulation area and the simulation is conducted with different mobility speed of 10, 20, 30, 40 m/s.

Scenario 2: In this scenario, the simulation area is 1500 m x 1500m and the transmission range is fixed for each node is 250 m and nodes are being displaced randomly at various location within the simulation area and the simulation is carried out at mobility speed of 10, 20, 30, 40 m/s.

4.3. Simulation parameter

The performance metrics can be computed with variation in mobility speed while rest of all other parameters like simulation time, number of nodes, packet size and transmission range kept constant. The Table-1 specifies the simulation parameters are used for the evolution.

Table-1. Simulation parameter.

Parameter	Scenario 1	Scenario 2
Simulation area (X)	700 m	1500 m
Simulation area (Y)	500 m	1500 m
Mobility speed	10,20,30,40 m/s	10,20,30,40 m/s
Transmission range	250 m	250 m
Simulation time	100 s	100 s
Mobility model	Random way point	Random way point
Traffic Type	CBR	CBR
Packet Rate	8 packets/sec	8 packets/sec
Packet size	512 bytes	512 bytes
Protocols evaluated	AODV,DSR,DSDV	AODV,DSR,DSDV

5. RESULTS AND DISCUSSIONS

The ability of protocols to deal with the route change by varying the mobility. The impact of mobility speed on both reactive and proactive routing protocols are explained as follows.

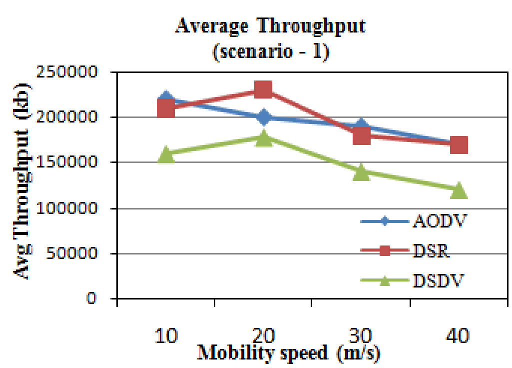

Figure-3. Graphical representation of average throughput in scenario1.

VOL. 10, NO. 8, MAY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences
©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.
www.arpnjournals.com

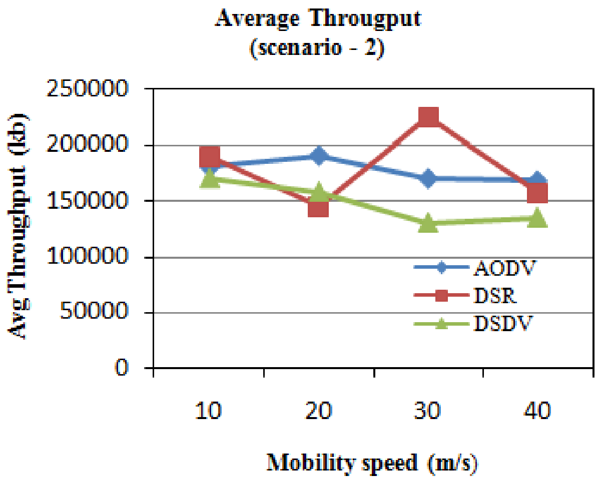

Figure-4. Graphical representation of average throughput in scenario 2.

Figures 3 and 4 shows average throughput with variation of mobility speed from 10, 20, 30, 40 m/s. When mobility speed increases, the average throughput is getting reduced and it is observed that the performance of DSR and AODV protocol is better than DSDV in both scenarios.

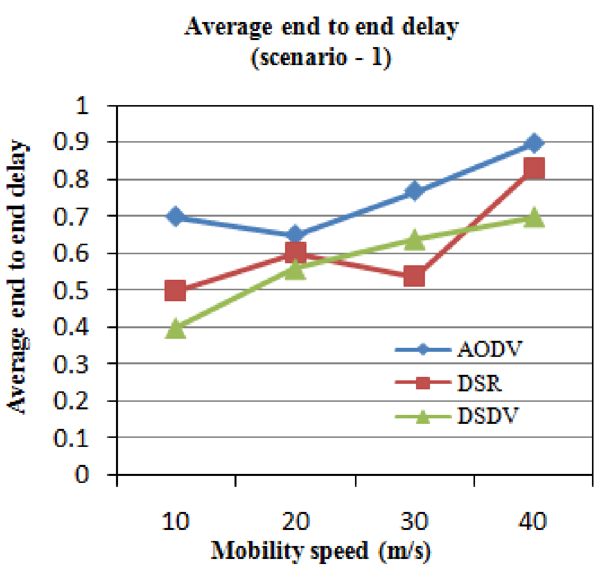

Figure-5. Graphical representation of average end to end delay in scenario 1.

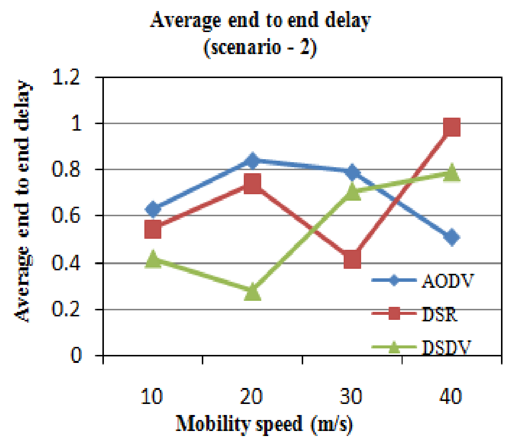

Figure-6. Graphical representation of average end to end delay in scenario 1.

The delay increases because the number of control packets is very high for searching new routes and maintains them throughout the network. Figures 5 and 6 shows average end to end delay in scenario 1 and 2 and it increases for all the three routing protocols with increasing mobility speed. DSDV exhibits a shorter delay comparatively because it is a kind of table driven routing protocol, each node maintains a routing table in which all of the possible destinations and AODV uses the source-initiated in the route discovery process, but at the route maintenance stage, it uses the way of the table-driven, which also shows the not better delay characteristic. Both DSDV and DSR is better performance than AODV.

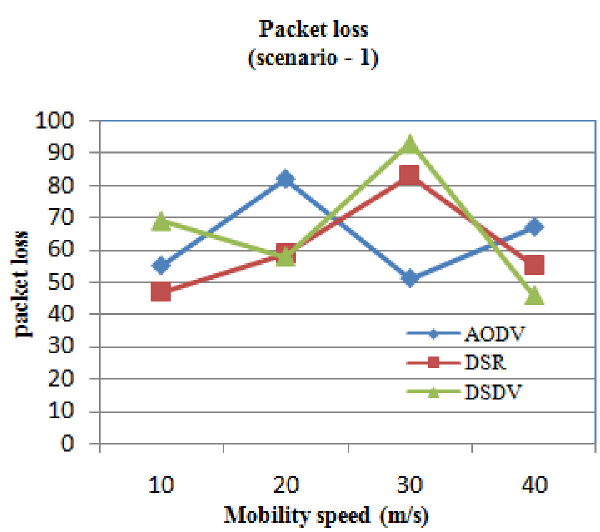

Figure-7. Graphical representation of packet loss in scenario 1.

©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.

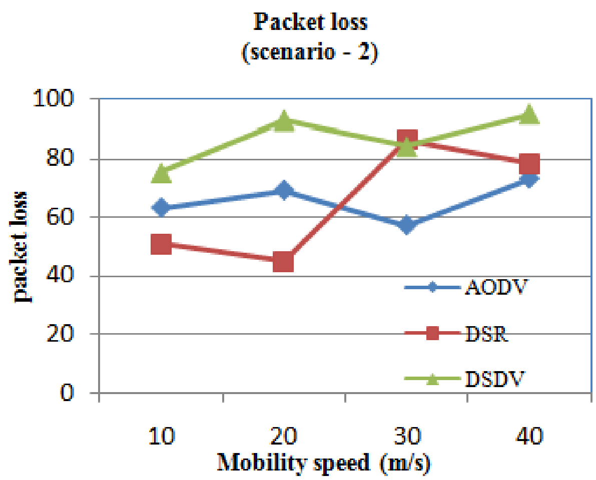

Figure-8. Graphical representation of packet loss in scenario 2.

Figures 7 and 8 shows packet loss in scenario 1 and 2 with varying mobility speed. AODV and DSR protocols deliver over 90% of packets for all considered values of pause time and maximum movement speed.

Table-2. Packet delivery ratio.

Scenario - 1 (700m x 500m)			
Mobility speed in m/s	**AODV**	**DSR**	**DSDV**
10	94.68	96.38	93.68
20	92.45	95.72	86.84
30	85.35	92.72	88.32
40	84.42	84.29	81.78
Scenario - 2 (1500m x 1500m)			
10	94.69	97.28	93.68
20	91.48	93.62	91.42
30	89.65	82.92	88.42
40	87.76	81.19	71.85

The given PDR values in Table-2 are filtered from trace file using AWK script. The PDR in percentage (%) and average delay are determined from every simulation run and set of sample values are is given: Average Throughput=9872, minimum delay=0.028960, maximum delay=1.392272, Average delay= 0.092819, total packets sent=430, total packets received= 386, total packets dropped=44 and packet delivery ratio=89.76 (%) for AODV in scenario - 2. AODV and DSR are better delivery ratio than DSDV, It is observed that the mobility plays considerable amount of impact on the three routing protocols as shown in Table-2.

6. CONCLUSIONS

The behavior of the mobile nodes with variation in mobility speed are analyzed and performance metrics are computed from two different scenarios, it is observed that the increasing the mobility speed does help to improve the performance of DSR and AODV. The throughput for CBR traffic in DSDV is drastically reduced than AODV and DSR with increasing mobility speed. In general, at low mobility all three protocols react in a similar way but mobility speed increases and for different traffic pattern, the DSR outperforms AODV and DSDV routing protocols. It is derived that the DSR and AODV performs much better than DSDV and also its noticed that the performance evaluation with not only increased mobility speed but also varying other related parameters such as different mobility models, radio propagation models, transmission range also.

REFERENCES

[1] S. Corson and J. Mocker. 1999. Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations [S]. RFC2501.

[2] T. Camp, J. Boleng and V. Davies. 2002. A survey of mobility models for Ad hoc network research. Wireless Communications and Mobile Computing (WCMC), Special issue on Mobile Ad Hoc Networking, Research, Trends and Applications.

[3] J. Yoon, M. Liu and B. Noble. 2003. Random waypoint considered harmful. In: INFOCOM 2003. pp. 1312-1321.

[4] University of Bonn, Bonn motion - "A mobility scenario generation and analysis tool. http://www.cs.unibonn.de/IV/bomonet/BonnMotion.htm.

[5] X.M. Zhang, E.B. Wang, J.J. Xia and D. K. Sung. 2011. An estimated Distance based Routing Protocol for Mobile Ad hoc Networks. IEEE Transactions on Vehicular Technology. 60(7): 3473-3484.

[6] Josh Broch, David A.Maltz, David B. Johnson, Yih-Chun Hu and Jorjeta Jetcheva. 1998. A performance comparison of multi-hop wireless ad hoc network routing protocols. In Proceedings of MobiCom'98, Dallas, TX.

[7] J. Broch, D. Johnson, and D. Maltz. 1998. The Dynamic Source Routing Protocol for Mobile Ad Hoc networks. IETF Internet Draft. (http://www.ietf.org/internet-drafts/draft-ietfmanet-dsr-01.txt).

[8] David B. Johnson, David A. Maltz and Yih-Chun Hu. 2004. The Dynamic Source Routing Protocol for

©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.

[9] Mobile Ad Hoc Networks, Internet-Draft, draft-ietf-manet-dsr-10.txt.

[10] Samir R. Das, Charles E. Perkins and Elizabeth M. Royer. 2000. Performance comparison of two on-demand routing protocols for ad hoc networks. In Proceedings of the IEEE Conference on Computer Communications (INFOCOM), Tel Aviv, Israel. pp. 3-12.

[11] S. R. Das, R. Castaneda, J. Yan, and R. Sengupta. 1998. Comparative performance evaluation of routing protocols for mobile, ad hoc networks. Proceedings of the International Conference on Computer Communications and Networks. pp. 153-161.

[12] C.E. Perkins and P. Bhagwat. 1994. Highly Dynamic Destination Sequence-Vector Routing (DSDV) for Mobile Computers, Computer Communication Review. 24(4): 234-244.

[13] C.E. Perkins and E.M. Royer. 1999. Ad-Hoc on-Demand Distance Vector Routing, Proc. Workshop Mobile Computing Systems and Applications. (WMCSA ’99). pp. 90-100.

[14] The network simulator - ns-2. http://www.isi.edu/nsnam/ns/.

[15] Charles E. Perkins and Pravin Bhagwat. 1994. Highly dynamic Destination-Sequenced Distance-Vector routing (DSDV) for mobile computers. In: Proceedings of the SIGCOMM’ 94 Conference on Communications Architectures, Protocols and Applications. pp. 234-244.

[16] C. Perkins. 2003. Ad hoc On-Demand Distance Vector (AODV) Routing, RFC3561 [S].

[17] T.S. Rappaport. 1995. Wireless Communications: Principles and Practice, Oct, Prentice Hall, Upper Saddle River, NJ.