Journal of Engineering and Applied Sciences 11 (Special Issue 2): 3265-3272, 2016
ISSN: 1816-949X

Comparison Study Between AODV and DSDV Performance Using NS2 (Reactive and Proactive)

Ahmed Naeem Jasim and Ravie Chandren Muniyandi
Softam, Faculty of Information Science and Technology, University Kebangsaan Malaysia, Bangi, Selangor, Malaysia

Abstract: Mobile Ad-hoc Network (MANET) are part of wireless and mobile networks and all the nodes in the network are able to communicate between them depending on infrastructure less without any fixed infrastructures like a router. The nodes connected each other through the wireless and by using Ad-hoc it's able to exchange the information among the source and the destination nodes. For interaction in Ad-hoc system, we need routing protocol for delivering the message effective within the time given. There are many routing protocols used to evaluate the performance of Ad-hoc. In this study, we used two of these routing protocols explained and evaluated based on the performance metric of the Destination-Sequenced Distance-Vector routing (DSDV) and Ad hoc On-demand Distance Vector (AODV). The network simulation version 2.35 (NS2) was used to perform the study. The result of the performance metrics was evaluated for these two routing protocols depend on Average throughput, average end-to-end delay, packet delivery ratio and packet loss ratio over different network metrics based on node packet size, speed and a number of nodes. Based on the result AODV routing protocol perform better than DSDV in most of applying the result.

Key words: Ad hoc on-demand Distance Vector (AODV), Destination-Sequenced Distance-Vector routing (DSDV),Mobile Ad-hoc Network (MANET), AD HOC net work, Malaysia

INTRODUCTION

Mobile Ad hoc Networks (MANET) are a set of wireless infrastructure less networks. The nodes in wireless infrastructure less networks utilizing the multi-hop technique without a fix station to collect with another node (Vukadinovic *et al*., 2014). The nodes in MANET move in an arbitrary manner because of its wireless network, so, the network's wireless topology always changes. The nodes in MANET unpredictable or it's so difficult to predict in MANET because there is no road like VANET and this is an important task in MANET. Several routing protocols for routing have been proposed in MANET to improve the routing in the network and to use the appropriate network performance to the desired environments we used two protocols for two type of routing protocols its Ad hoc On-Demand Distance Vector (AODV) (Geetha *et al*., 2006) which is reactive routing protocol and Destination-Sequenced Distance Vector (DSDV) (Verma *et al*., 2007) which is proactive routing protocol. The performance of any routing protocol based on the mechanism of the protocol for how to transfer the date as well on the length of interconnections between the nodes around the network. For the Ad hoc network, it has features like durability, fast deployment, flexibility and mobility (Tavli and Heinzelman, 2006; Boukerche, 2008). The aim of using the Ad hoc network is to be more flexibility which is able to connect with any applications. The challenges to maintain the Ad hoc network is the mobility because of there are not authority for central controlling because it keeps changing the movement. Mobile Ad hoc network is easy to implement in vehicles, Wi-Fi protocols and Bluetooth (Tavli, 2006; Boukerche, 2008; Perkins *et al*., 2001).

Several routing protocols used for MANET and every protocol have its own mechanism, in this study, we used only two protocols (DSDV) and (AODV). MANET it is many nodes can connect with each other without using any fixed network like the router that's mean it based on infrastructure less network. Because of MANET environment, many routing protocols mechanism proposed and everyone has its own performance, so in this study, we will compare between two routing protocol reactive like (AODV) and proactive like (DSDV) to check the performance between them. We can see the performance for many routing protocols comparison already done like like (Boukerche, 2004). This study aim of this comparison is to determine which protocol of these

Corresponding Author: Ahmed Naeem Jasim, Softam, Faculty of Information Science and Technology, University Kebangsaan Malaysia, Bangi, Selangor, Malaysia

routing protocols is better and more efficient in terms of PDR, E2E Delay, PLR and average throughput. We have chosen these protocols because they are widely known and mostly used. Hoping this study will be useful and helpful to students and researchers in the field.

MATERIALS AND METHODS

Many routing protocols can be classified according to various approaches classification of routing protocols (reactive, proactive and hybrid) for MANET (Fig. 1).

Proactive routing protocols also are known as "table driven." Proactive routing is up-to-date protocols because it maintains consistently in giving routing information and it is originally from therouting table and in the meantime ready to find route despite the fact that the information exists or not. In reactive routing protocols routing process is done by flooding route request packet to the whole network (Bhatia and Sharma, 2016). Advantages of this routing protocol it can discover the shortest path at the time needed which is able to reduce delays. The disadvantageof this type of routing protocol is support resistance to network topology changes. We can use DSDV and Optimized Link State Routing (OLSR) as anexample for proactive routing protocols.

Reactive routing protocols also called "On Demand Routing Protocols." These routing protocols able to sustain network currently when a few of available routes use at any time. The route discovery in this mechanism depends on flooding algorithm. In this technology the node broadcast the packet to all the neighbors and for the intermediate nodes forward that packet to nearby nodes.Reactive routing protocol schemes determine the route when needed (Tyagi and Chauhan, 2010). Reactive techniques have less routing overheads but higher latency, an example of AODV, Dynamic Source Routing (DSR).

AODV routing protocols: AODV or on-demand routing protocol is a reactive routing protocol designed for ad hoc networks up to thousands of nodes (Mohammed and Alsaqour, 2006). In this, nodes preserve traditional routing tables specifying the next hop to take to reach the destination (Mohammed and Alsaqour, 2006). AODV is only able to request route when need it. Route Request RREQ, Route Reply (RREP) Packet and Route Error (RERR), makes route discovery in AODV. PREQ send the packet to the neighbors until the destination discovery or the time of thepacket is finish (Abdelhaq *et al*., 2011). The destination or route to destination updating through PREP-based on the routing table. The node will choose the short route to atarget when it receives many PREP packets from the same destination. AODV able to handle

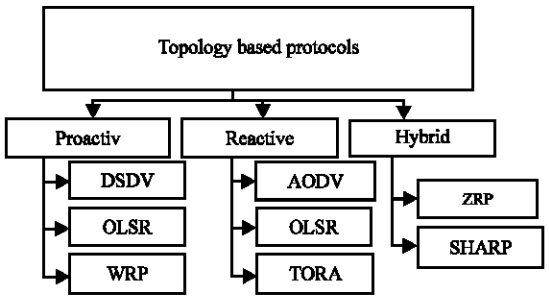

Fig. 1: Classification of MANET routing protocols (Gupta, 2016)

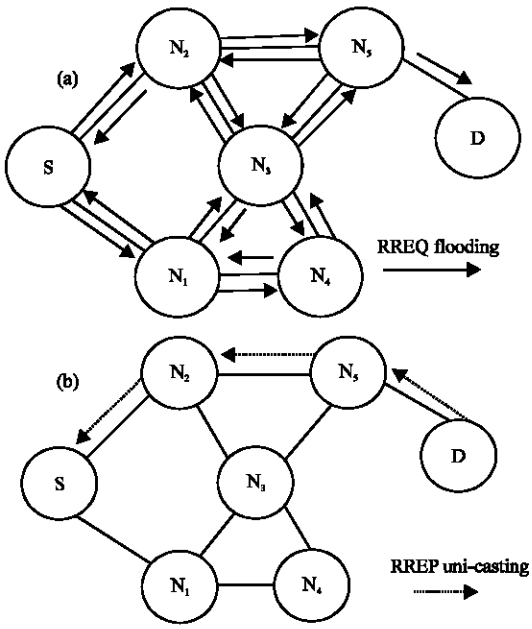

Fig. 2: AODV routing protocol: a) RREQ messages and b) RREP message (Abdelhaq *et al*., 2014)

the changes in the routes and able to creating new routes is there is a mistake because AODV does not contain loops. The illustration of AODV routing protocol in Fig. 2.

DSDV routing protocol: DSDV IS proactive routing protocol (Perkins and Bhagwat, 1994). DSDV routing protocol used scheme known as a table driven and it used in mobile networks based on an algorithm known as Bellman-ford (Perkins and Bhagwat, 1994). By used sequence numbers it showing the improvement that had been made to the Bellman-ford algorithm it contained freedom from loops in the routing table (Perkins and Bhagwat, 1994). Every node in the network have the routing table and this table has all the information of this

node. In the same time, this node is known as the router in MANET concept and the network can find the route if the route is needed or not. Each route to the destination node associated with sequence number to avoid routing loops. Even if the network in idle case and that's mean it used network bandwidth and battery the exchanging of routing update occur. Thus, it is not preferable for highly dynamic networks.

Simulation environmentand analysis method: In our study we compared between two popular routing protocols AODV and DSDV we performed using network Simulation which is famous, easy to use and research to simulate the network protocols. We use three performance metrics to compare between these two protocols its.

Packet Delivery Ratio (PDR): PDR is the ratio of data packets delivered to the destination to those generated by the sources. It is calculated as follow:

$$PDR = \frac{\text{Number of packets received}}{\text{Number of packets sent}} \times 100 \quad (1)$$

Average Throughput (TP): Average TP is the number of bytes received successfully and it is calculated as follow:

$$TP = \text{Number of bytes received} \times 8 \times \text{simulation time} \times 1000 \text{ kbps} \quad (2)$$

Average End-to-End Delay (E2E delay): Average E2E delay is the average time of the data packet which is a need to send from source node to the destination through the network. It includes all possible delays such as buffering during the route discovery latency, queuing at the interface queue, retransmission delay at the MAC, the propagation and the transfer time. The average e2e delay is computed as follow:

$$\text{e2e delay} = \frac{\sum_{i=1}^{n}(R_i - S_i)}{n} \quad (3)$$

Where:

- n = The number of data packets successfully transmitted over the network
- i = The unique packet identifier
- R_i = The time at which a packet with a unique identifier i is received
- S_i = The time at which a packet with a unique identifier i is sent

Packet Loss (PL): PL is different between the number of data packets sent and the number of data packets received. It is calculated as follow:

Table 1: Simulation parameters

Parameter	Values
Simulation time	160 sec
Number of nodes	5, 10, 15, 20
MAC type	802.11
Queue type	Drop-tail
Radio propagation model	Two-ray ground
Antenna model	Omni antenna
Routing protocol	AODV, DSDV
Traffic model	TCP
Maximum speed	5, 10, 15, 20, 25 m sec^{-1}
Network area size	600×600 m
Packet size	500, 1000, 1500, 2000, 2500 bytes
Mobility model	RWP

$$PL = \text{Number of data packets sent} \quad \text{Number of data packets received} \quad (4)$$

Simulation set-up: We use NS_2 simulation to compare between (AODV) and (DSDV) protocols. In this study, NS2 utilize C++ language and tool command language. The size area for the simulation we used is 600×600 m also we used two-ray ground model, the shared wireless channel bandwidth considered to be 2 MHz and the nodes used MAC protocol 802.11 and network protocol IP come with queue size output as 50. The transmission range is set to be around 250 m for all the nodes in the network. We describe all the parameters for the simulation we used in Table 1.

The Random Waypoint Model (RWP) is a random model for the movement of mobile users and how their location, velocity and acceleration change over time. Mobility modelsare used for simulation purposes when new network protocols are evaluated. The random waypoint model was first proposed by Johnson and Maltz (1996). It is one of the most popular mobility models to evaluate Mobile Ad Hoc Network (MANET) routing protocols because of its simplicity and wide availability.

RESULTS AND DISCUSSION

In our simulation, we will create two OTCL files, one for AODV protocol and another OTCL file for DSDV protocol. We write the code in each protocol depends on our scenario which contains network performance and performance metric. We use trace file to analyze the results. The average end to end delay, Packet Delivery Loss (PDL) and Packet Delivery Ratio (PDR), average through puttaking into consideration the number of nodes, packet size and node speed variable. The performance of routing protocol can be evaluated utilizing quantitative measurements. Routing protocol performance can be assessed using quantitative metrics is depicted as in the following valuations: (Barakovic and Barakovic, 2010; Wang *et al*., 2014; Hakak *et al*., 2014).

Effect of node speed: The first effect of the network metrics is the speed and can be shown in Fig. 3. Figure 3,

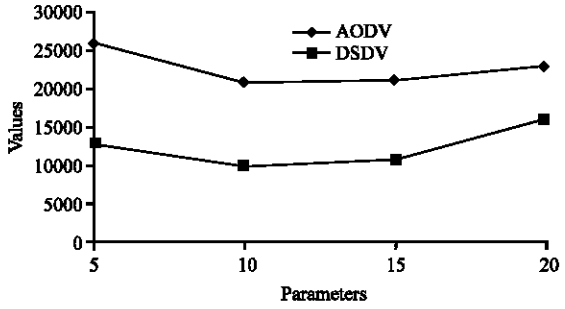

Fig. 3: Speed and AVG THR

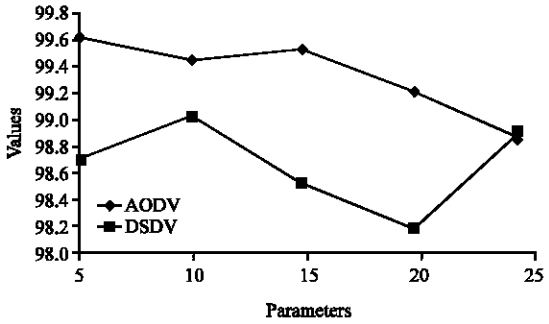

Fig. 4: Speed and PDR

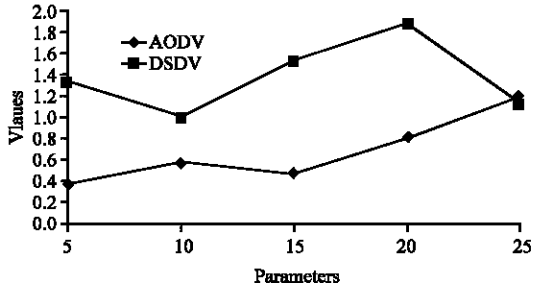

Fig. 5: Speed and PLR

we can observe that Avg throughput in AODV protocol higher than DSDV protocol when we increase the speed of nodes. We initiate the simulation with the value of speed 5 until the end of simulation with speed value 25. Figure 4 presents the performance of AODV protocol higher PDR than DSDV protocol when we increase the node speed just in speed 25 we can see that DSDV value (98.88%) higher than AODV value (98.82%), PDR refer to the packets arrive at the destination. Figure 5 AODV routing protocol better than DSDV for the number of lost packets ratio but in speed value 25 we can see DSDV protocol performance better than AODV protocol. Finally, in Fig. 5, we can observe that the performance for both protocols not stable for Avg E2E delay as we can see in speed value (5, 20, 25) faster for DSDV and in speed value (10, 15) faster for AODV.

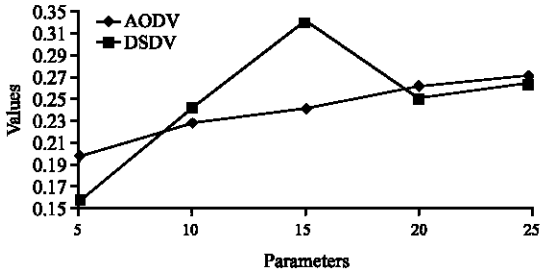

Fig. 6: Speed and AVG E2E

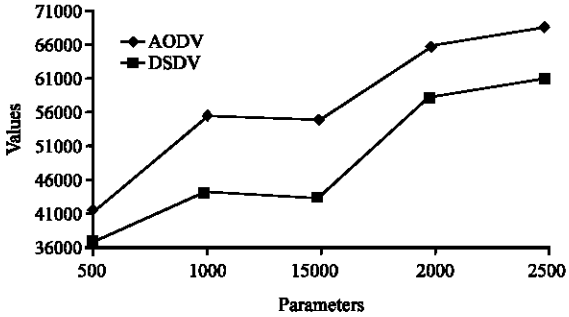

Fig. 7: Packet size and AVG THR

Based on the result, we can observe that AODV protocol better than DSDV protocol in AVG THR because of AODV is reactive routing protocol (on demand). The route discovery in this mechanism depends on flooding algorithm. In this technology the node broadcast the packet to all the neighbors and for the intermediate nodes forward that packet to nearby nodes. Reactive routing protocol schemes determine the route when needed. Moreover, we can observe that AODV protocol better than DSDV protocol in PDR and PLR but for the last speed value (25) we can see the DSDV protocol higher value. Finally, AVG E2E delay the performance of AODV protocol and DSDV protocol not stable due to the collision occurred (Table 2-5).

Effect of packet size: The second effect of the network metrics is the packet size and can be shown in figures below. Figure 6 and 7 we show the average throughput during changing in packet size ThatAODV through have better performance than DSDVAVG through at the simulation time. Two protocols start in packet size 500 bytes and we increase these packets 500 bytes until we stop at the end of simulation at 2500 bytes. Figure 8 presents the changing of packet size during average E2E delay, DSDV protocol has less delay time than AODV when increasing of packet size, thestarting/end journey present the better performance for DSDV. In Fig. 9, it is shown that the packet delivery ratio of AODV protocol is more better than the DSDV protocol when the packet size

Table 2: The result values for AVG E2E and speed

Speed	AODV	DSDV
5	0.202504	0.160661
10	0.234926	0.253151
15	0.250973	0.338928
20	0.271324	0.260455
25	0.282933	0.277357

Table 3: The result values for AVG THR and speed

Speed	AODV	DSDV
5	24748.61	12080.62
10	21128.92	10241.27
15	19521.56	5575.170
20	17435.29	8453.50
25	15662.48	11586.74

Table 4: The result values for PDR and speed

Speed	AODV	DSDV
5	99.61	98.67
10	99.42	98.99
15	99.52	98.47
20	99.18	98.11
25	98.82	98.88

Table 5: The result values for PLR and speed

Speed	AODV	DSDV
5	0.39	1.33
10	0.58	1.01
15	0.48	1.53
20	0.82	1.89
25	1.18	1.12

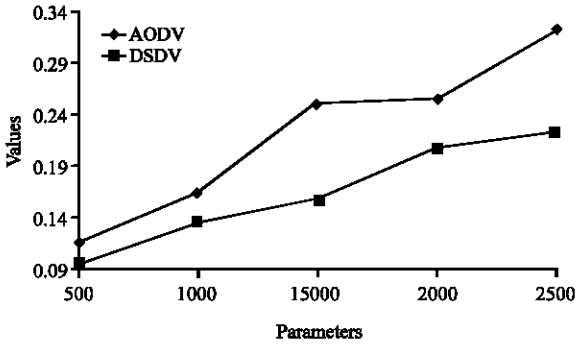

Fig. 8: Packet size and AVG E2E

Table 6: The result values for AVG THR and packet size

Packet size	AODV	DSDV
500	41115.71	36465.81
1000	55129.84	43967.43
1500	54872.69	43205.59
2000	65547.86	58178.71
2500	68449.70	60685.00

Table 7: The result values for AVG E2E and packet size

Packet size	AODV	DSDV
500	0.112340	0.0924312
1000	0.163736	0.1342580
1500	0.248901	0.1563030
2000	0.254318	0.2049200
2500	0.321473	0.2203580

Table 8: The result values for PDR and packet size

Packet size	AODV	DSDV
500	99.81	99.62
1000	99.71	99.65
1500	99.28	99.21
2000	99.18	99.08
2500	99.39	99.32

Table 9: The result values for PLR and packet size

Packet size	AODV	DSDV
500	0.19	0.38
1000	0.29	0.35
1500	0.72	0.79
2000	0.82	0.92
2500	0.61	0.68

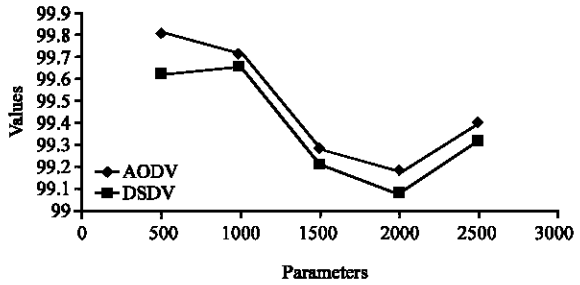

Fig. 9: Packet size and PDR

increasing. Finally, we can observe that PLR in AODV less than DSDV and that's mean AODV have better performance than DSDV.

Based on the result, we can observe that AODV protocol better than DSDV protocol in these metrics PDR, PLR and AVG THR because of AODV is reactive routing protocol [on demand]. The route discovery in this mechanism depends on flooding algorithm. In this technology the node broadcast the packet to all the neighbors and for the intermediate nodes forward that packet to nearby nodes. Reactive routing protocol schemes determine the route when needed. DSDV has proactive nature and it cannot form routing table proficiently with the dynamically changing network.

In AVG E2E delay, the performance of DSDV protocol is better than AODV protocol while in DSDV protocol which is a proactive routing protocol, the nodes in this type of routing protocols have a table of routing information for all other nodes. However, when the node needs to send a data there is no need to searching for the routes because the routes have been identified. Therefore, the route discovery process in proactive routing protocols is performed faster than reactive routing protocols so that refer to DSDV protocol better than AODV protocol (Table 6-9).

Effect of number of nodes: In the below Fig. 10-14, we observe the performance metrics when a number of nodes changes in AODV and DSDV protocols. In Fig. 11, we can see the Avgthroughput in AODV protocol higher than DSDVprotocol when we increase the number of nodes. In Fig. 12 the avg E2E delayfor DSDV protocol significantly better than AODV Average E2E delaywhen changing a number of nodesbut at the node 20 the AODV protocol

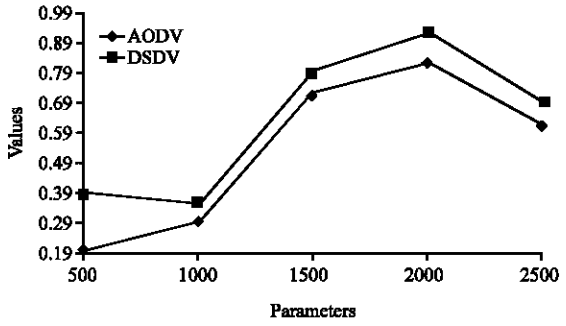

Fig. 10: Packet size and PLR

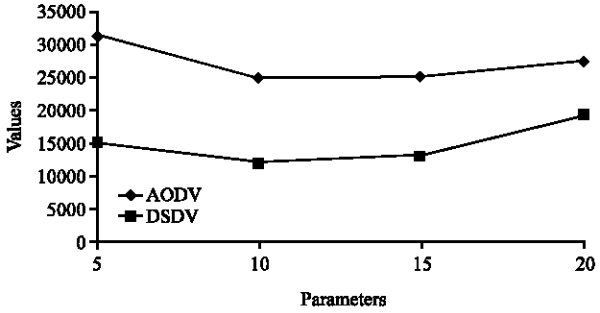

Fig. 11: No. of node and AVG THR

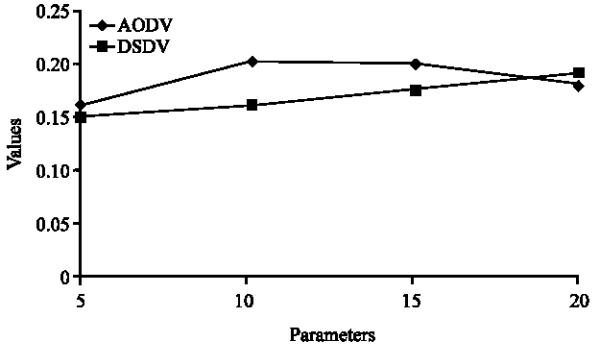

Fig. 12: No. of node and AVG E2E

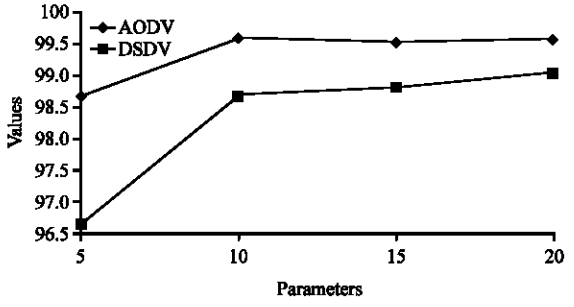

Fig. 13: No. of nodes and PDR

slightly lesser than DSDV protocol, due to the collision occurred in DSDV protocol. Figure 13 presents the

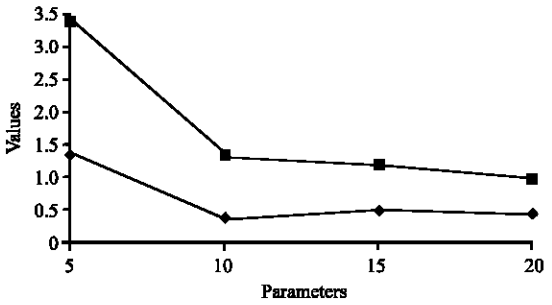

Fig. 14: No. of node and PLR

Table 10: The result values for AVG THR and no. of node

No. of node	AODV	DSDV
5	31150.29	14928.80
10	24748.61	12080.62
15	25190.04	13189.64
20	27303.09	19154.98

Table 11: The result values for AVG E2E and no. of node

No. of node	AODV	DSDV
5	0.160712	0.149837
10	0.202504	0.160661
15	0.198162	0.175049
20	0.180026	0.189636

performance of AODV protocol higher PDR than DSDV protocol even deferent changing during a varying number of nodes, PDR refer to the packets arrive at the destination. Finally in Fig. 14 AODV routing protocol better than DSDV for the number of lost packets ratio.

Based on the result, we can observe that AODV protocol better than DSDV protocol in these metrics PDR,PLR and AVG THR because of AODV is reactive routing protocol [on demand]. The route discovery in this mechanism depends on flooding algorithm. In this technology the node broadcast the packet to all the neighbors and for the intermediate nodes forward that packet to nearby nodes. Reactive routing protocol schemes determine the route when needed. DSDV has proactive nature and it cannot form routing table proficiently with the dynamically changing network.

In AVG E2E delay, the performance of DSDV protocol is better than AODV protocol while in DSDV protocol which is a proactive routing protocol, the nodes in this type of routing protocols have a table of routing information for all other nodes. However, when the node needs to send a data there is no need to searching for the routes because the routes have been identified. Therefore, the route discovery process in proactive routing protocols is performed faster than reactive routing protocols, sothat refer to DSDV protocol better than AODV protocol but at the node 20 the AODV protocol slightly lesser than DSDV protocol, due to the collision occurred in DSDV protocol (Table 10-13).

Table 12: The result values for PDR and no. of node

No. of node	AODV	DSDV
5	98.66	96.67
10	99.61	98.67
15	99.50	98.81
20	99.55	99.03

Table 13: The result values for PLR and no. of node

No. of node	AODV	DSDV
5	1.34	3.33
10	0.39	1.33
15	0.50	1.19
20	0.45	0.97

CONCLUSION

This study analysis and evaluate the performance metrics of two routing protocols AODV and DSDV using NS-2. We compared between two routing protocols depend on three network parameters: (packets size, the number of nodes and node speed) using different performance metrics such as Average throughput (AVG THR), Average E2E delay (AVG E2E delay), Packet Delivery Ratio (PDR) and Packet Loss Ratio (PLR). On the other hand, the studied routing protocols have different behavior under RWP mobility model. In our comparison and based on performance metrics and network parameters we can see obvious AODV routing protocol better performance than DSDV routing protocol. The study performed over three network parameters node speed, packet size and number of nodes In the first scenario for node speed, we concluded AODV routing protocol has better performance than DSDV simulated protocolthrough routing large number of nodes and provided high-performance in AVG throughput, Packet Delivery Ratio (PDR) and Packet Loss Ratio (PLR). On the other hand AVG E2E delay of AODV protocol and DSDV protocol not stable due to the collision occurred. Second scenario results scenario for packet size show AODV better than DSDV in PDR, PLR, AVG THR through simulation time but DSDV better than AODV in AVG E2E delay because it's faster. Finally, with the third scenario number of nodes, we can obvious its same second scenario.

ACKNOWLEDGEMENT

This study was supported by Dana Impak perdana (DIP-2014-037) of the Universiti Kebangsaan Malaysia (UKM).

REFERENCES

Abdelhaq, M., R. Hassan and M. Ismail, 2014. Performance evaluation of mobile ad hoc networks under flooding-based attacks. Intl. J. Commun. Syst., 27: 4328-4345.

Abdelhaq, M., S. Serhan, R. Alsaqour and A. Satria, 2011. Security routing mechanism for black hole attack over AODV MANET routing protocol. Aust. J. Basic Applied Sci., 5: 1137-1145.

Barakovic, S. and J. Barakovic, 2010. Comparative performance evaluation of Mobile Ad Hoc routing protocols. Proceedings of the 33rd International Convention on MIPRO, May 24-28, 2010, IEEE, New York, USA., ISBN:978-1-4244-7763-0, pp: 518-523.

Bhatia, D. and D.P. Sharma, 2016. A comparative analysis of proactive, reactive and hybrid routing protocols over open source network simulator in mobile ad hoc network. Intl. J. Appl. Eng. Res., 11: 3885-3896.

Boukerche, A., 2004. Performance evaluation of routing protocols for ad hoc wireless networks. Mobile Networks Appli., 9: 333-342.

Boukerche, A., 2008. Algorithms and Protocols for Wireless, Mobile Ad Hoc Networks. Wiley-IEEE Press, New York.

Geetha, V., S. Aithal and K. ChandraSekaran, 2006. Effect of mobility over performance of the ad hoc networks. Proceedings of the International Symposium on Ad Hoc and Ubiquitous Computing, December 20-23, 2006, IEEE, New York, USA., ISBN:1-4244-0731-1, pp: 138-141.

Gupta, P., 2016. A literature survey of MANET. Intl. Res. J. Eng. Technol., 3: 95-99.

Hakak, S., F. Anwar, S.A. Latif, G. Gilkar and M.K. Alam, 2014. Impact of packet size and node mobility pause time on average end to end delay and Jitter in MANET's. Proceedings of the 2014 International Conference on Computer and Communication Engineering (ICCCE), September 23-25, 2014, IEEE, New York, USA., ISBN:978-1-4799-7635-5, pp: 56-59.

Johnson, D.B. and D.A. Maltz, 1996. Dynamic source routing in Ad hoc wireless networks. Mobile Comput., 353: 153-181.

Mohammed, Y.I. and R.A. Alsaqour, 2006. Comprehensive comparison study for routing protocols in mobile ad-hoc network using NS2. ARPN. J. Eng. Appl. Sci., 11: 9205-9211.

Perkins, C.E. and P. Bhagwat, 1994. Highly dynamic destination-sequenced distance-vector routing (DSDV) for mobile computers. ACM SIGCOMM Comput. Commun. Rev., 24: 234-244.

Perkins, C.E., E.M. Royer, S.R. Das and M.K. Marina, 2001. Performance comparison of two on-demand routing protocols for ad hoc networks. IEEE. Pers. Commun., 8: 16-28.

Tavli, B. and W. Heinzelman, 2006. Mobile Ad Hoc Networks: Energy-Efficient Real-Time Data Communications. Springer Science and Business Media, Berlin, Germany, ISBN: 978-1-4020-4632-2, Pages: 265.

Tyagi, S.S. and R.K. Chauhan, 2010. Performance analysis of proactive and reactive routing protocols for ad hoc networks. Intl. J. Comput. Appl., 1: 27-30.

Verma, B., S. Jain and V. Pitti, 2007. Real time on-demand distance vector routing in mobile ad hoc networks. Asia J. Inform. Technol., 5: 454-459.

Vukadinovic, V., F. Dreier and S. Mangold, 2014. Impact of human mobility on wireless ad hoc networking in entertainment parks. Ad Hoc Netw., 12: 17-34.

Wang, Z., Y. Chen and C. Li, 2014. PSR: A lightweight proactive source routing protocol for mobile ad hoc networks. IEEE. Transac. Veh. Technol., 63: 859-868.