Analysis of the Effect of Mobility Model and Traffic Agent Variations on Routing Protocol Performance on Mobile Ad-Hoc Network

Barokatun Hasanah, Indra Mahardika, Himawan Wicaksono, and Mifta Nur Farid

Abstract The wireless network is a communication network that allows users to communicate with each other without using a wired intermediary. One of the most popular wireless network technologies is the mobile ad-hoc network (MANET). The proper routing protocol is needed in designing the MANET network because each user acts as a router or determines his path in sending information to the intended user. Mobility models and traffic agents also affect the performance of the MANET network route protocol. The mobility model represents users' movement in every condition of the MANET network, and the traffic agent acts as a protocol that allows users to connect and share information. This research used AODV, DSDV, and DSR as the routing protocols. Random waypoint and Manhattan grid are used as the mobility model. TCP/FTP and UDP/CRB are used as the traffic agent. The DSR protocol has the highest throughput and packet delivery ratio values in each variation of mobility models with TCP/FTP traffic agent with the highest value of 638 Kbps at 60 node variation and 99.95% packet delivery ratio at 20 node variation. In comparison, the AODV protocol has higher throughput and packet delivery ratio values for each variation of mobility models with UDP/CBR traffic agents with the highest values of 85 Kbps and 99.93%. The residual energy values for the AODV and DSR protocols have relative values, but the DSR protocol holds the highest value for all variations of 20, 40, 60, 80, and 100 nodes. The highest residual energy value is in the variation of 100 nodes random waypoint TCP/FTP with 24798.73 J.

Keywords MANET · Mobility model · Traffic agent

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1 Introduction

The development of information technology in Indonesia is proliferating due to the public's need for ease and speed in obtaining information which is getting higher day by day. One information technology that provides convenience in communicating and obtaining information is wireless technology. Wireless technology allows users to communicate and obtain information in mobile conditions. One of the wireless network technologies that is popular and widely researched because of its flexibility in modeling and cost-effectiveness is the mobile ad-hoc network (MANET) [1].

MANET technology is suitable for use as an emergency network in Indonesia because many areas in Indonesia lack telecommunications network infrastructure. In addition, MANET technology can be used as a solution in the event of a natural disaster in Indonesia that causes damage to the telecommunications network infrastructure in the area [2, 3].

In a MANET network, each node is connected to other nodes wirelessly, and these nodes can move freely within the network coverage. It allows the MANET network topology to change from time to time and allows for redundancy in transmitting information between nodes [4].

The routing protocol on the MANET network is helpful so that nodes can determine the path or route they want to go. Routing protocols are divided into three classes based on their performance and function on the MANET network, namely proactive routing protocols, reactive routing protocols, and hybrid routing protocols. Each type of protocol has its advantages and disadvantages [5].

Several parameters can influence the value of the quality of service (QoS) routing protocol, including mobility model parameters. Each mobility model has characteristics that can cause QoS values such as throughput, packet delivery ratio, and residual energy of each routing protocol to be different. Each routing protocol has its path in sending or forwarding data. Mobility models can also represent the conditions of an environment because the movement of users in each mobility model is different [6].

Data traffic scenarios are required for data transmission at each node in the MANET network. It can affect the QoS value in each routing protocol in the MANET network. Because each traffic agent is responsible for sending data, it is essential to note that each traffic agent has different characteristics. So simulation is needed to determine the type of protocol and traffic model suitable for environmental conditions and user movements on the MANET network [7].

The QoS performance test of AODV, DSR, and TORA reactive routing protocols has been tested. It was found that the AODV routing protocol has a better QoS value than DSR and TORA. In addition, the QoS performance test of the AODV, ZRP, and AODVDR routing protocols was also carried out. It was found that the ZRP hybrid routing protocol has a better QoS value than AODV and AODVDR [8].

Research has been done on using two traffic agents, namely TCP/FTP and CBR/UDP, using the AODV routing protocol. It was found that TCP/FTP has a better throughput value than CBR/UDP. However, the packet delivery ratio of the two traffic models has a consistent performance in every scenario [7].

Table 1 Hardware requirements

Component	Specification
Operating system	Linux Ubuntu 64 bit
CPU	Intel Core i5 8250U CPU @ 3.4 GHz
Memory	8 GB
Harddisk	100 GB

Research has also been carried out on the selection of mobility models in the design of the MANET network. Two mobility models have been used, namely random waypoint and MANET down left, using the OLSR routing protocol. It was found that the random way point model has a better QoS value than the MANET down left [9].

Thus, based on previous studies, this study will analyze the effect of variations in mobility models and traffic agents on the performance of routing protocols in the MANET network. Routing protocols used are AODV, DSDV, and DSR. The mobility models used are random waypoints and Manhattan grids. Furthermore, FTP/TCP and UDP/CBR are the traffic agent models used.

2 Method

2.1 Simulation Environment

The system design was carried out using the Acer Aspire E5-476G-58KE laptop with specifications that can be seen in Table 1

While the software used in designing the system is as follows:

1. Network Simulator 2.35 is used to design the MANET network.
2. Text Editor is used to creating scripts based on Tcl and C++ MANET network design.
3. AWK Script to calculate the quality of service value from the simulation that has been made
4. BonnMotion used to create the mobility model we want

2.2 Simulation Models

There are four simulation models carried out. Models I and II use the random waypoint, while Models III and IV use the Manhattan grid with the parameters used are shown in Table 2.

Table 2 Parameter for models I, II, III, and IV

Parameters	Model I	Model II	Model III	Model IV
Mobility models	Random waypoint		Manhattan grid	
Traffic agent type	FTP	CBR	FTP	CBR
Data type	TCP	UDP	TCP	UDP
Network size	1000 m m × 1000 m m			
Routing protocol	AODV, DSDV, and DSR			
Number of nodes	20, 40, 60, 80, dan 100			
Simulation time	1000 s			
Propagation model	Two ray ground			
Speed of mobile nodes	0.1–2 m/s			
Initial energy	1000 J			
Idle power	0.8 W			
Rx power	1 W			
Tx power	1.3 W			
Sleep power	0.003 W			
Packet size	512 bytes			
Max pause	5 s			
Block size	4 × 4			

3 Result and Discussion

In this section, a comparison of each model's throughput, packet delivery ratio, and residual energy will be shown.

3.1 Throughput Versus Node

The throughput graphs against nodes from Models I, II, III, and IV are shown in Figs. 1, 2, 3, and 4, respectively.

Figure 1 shows that DSR has a higher throughput value than others because it uses cache routing to form transmission paths so that nodes with many DSR protocols still have effective routing paths. Figure 2 shows that the AODV protocol has a superior value than others. The UDP/CBR traffic agent sent data or packets directly, and there is no checking that the data sent has been damaged or has not arrived at its destination. Hence, the throughput value for UDP/CBR is small. The AODV protocol is very suitable for use in CBR/UDP scenarios. Figure 3 shows that the AODV protocol has a superior value than others. The AODV protocol has a better

Fig. 1 Graph of throughput against nodes from Model I

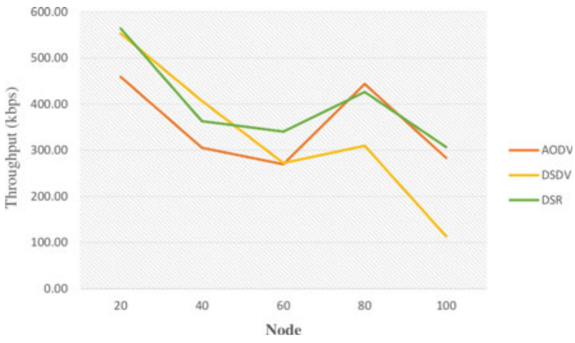


Fig. 2 Graph of throughput against nodes from Model II

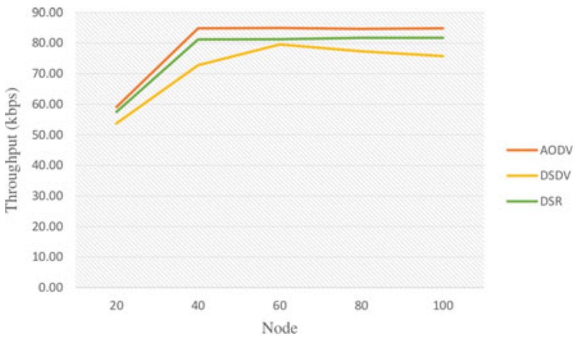


Fig. 3 Graph of throughput against nodes from Model III

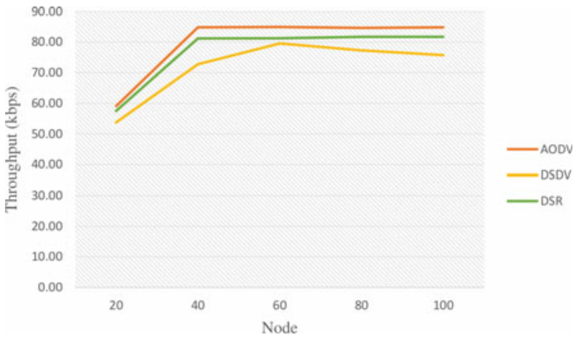
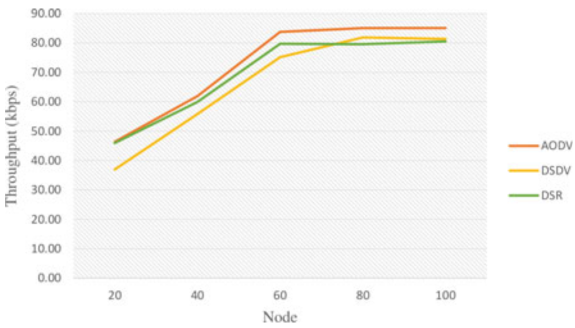


Fig. 4 Graph of throughput against nodes from Model IV



value in the Manhattan mobility model because the grid's topology does not change randomly. Hence, route discovery is not too difficult. Figure 4 shows that the AODV protocol has a higher value on large nodes because the AODV protocol does not maintain either the route already in use or on subsequent deliveries. The AODV protocol will find the correct route again, which is very suitable if it has adjacent nodes. In the UDP/CBR scenario, data is sent directly from the node. Moreover, there is no packet numbering or re-checking of packets.

3.2 *Packet Delivery Ratios (PDR) Versus Node*

The graphs of packet delivery ratios against nodes from Models I, II, III, and IV are shown in Figs. 5, 6, 7, and 8, respectively.

Figure 5 shows that DSR has a higher PDR value than others because it has routing discovery which helps find the best route to get to the destination. Figure 6 shows that AODV and DSR have almost the same PDR values at each node. The PDR value of UDP/CBR is smaller than TCP/FTP due to the absence of numbering and re-checking the data. Figure 7 shows that the DSR protocol excels in all nodes. The DSR protocol has a high and stable PDR value, although it has routing discovery which helps find the best route to get to the destination. The Manhattan grid scenario

Fig. 5 Graph of packet delivery ratio against nodes from Model I

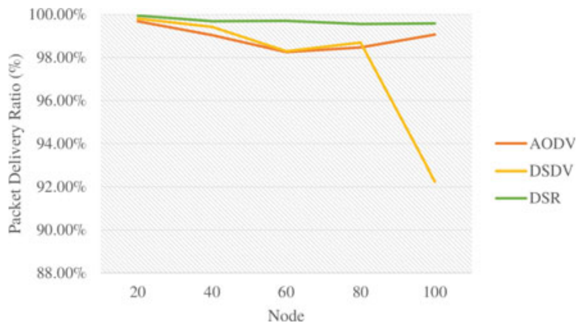


Fig. 6 Graph of packet delivery ratio against nodes from Model II

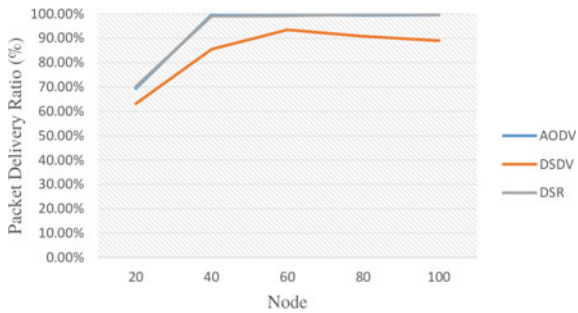


Fig. 7 Graph of packet delivery ratio against nodes from Model III

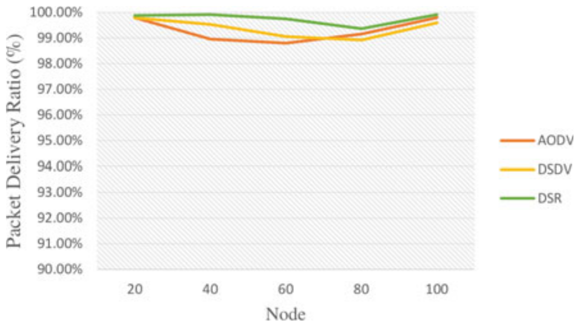
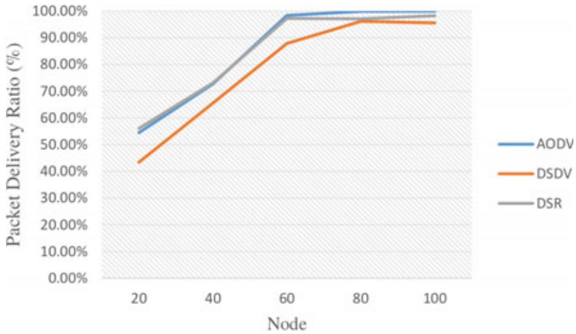


Fig. 8 Graph of packet delivery ratio against nodes from Model IV



also causes a decrease in PDR. It does not allow users to move freely, so data may not reach the destination. Figure 8 shows that the small PDR value on the Manhattan grid with UDP/CBR is caused by the node being unable to connect because the sender is far away. Also, CBR/UDP does not have data re-checking.

3.3 Residual Energy (RE) Versus Node

Graphs of residual energy value against nodes from Models I, II, III, and IV are shown in Figs. 9, 10, 11, and 12, respectively.

Figure 9 shows that AODV has a higher residual energy value at 80 nodes. In comparison, DSDV excels at 40 nodes. However, DSR has superior values at 20, 60, and 100 nodes. Each network protocol has a residual energy value that does not differ much. Figure 10 shows that DSDV has a higher residual energy value than others at 40 nodes. Meanwhile, DSR has superior values at 20, 60, 80, and 100 nodes. Figure 11 shows that the DSR protocol excels at 20, 40, 60, and 100 nodes. In comparison, the DSDV protocol excels at 80 nodes. Each network protocol has a RE value that does not differ much because the protocol will choose the closest path or the best path in sending data to the destination node. The best residual value is in the DSR

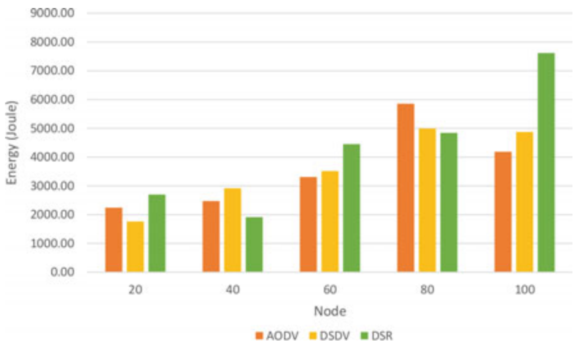


Fig. 9 Graph of residual energy against nodes from Model I

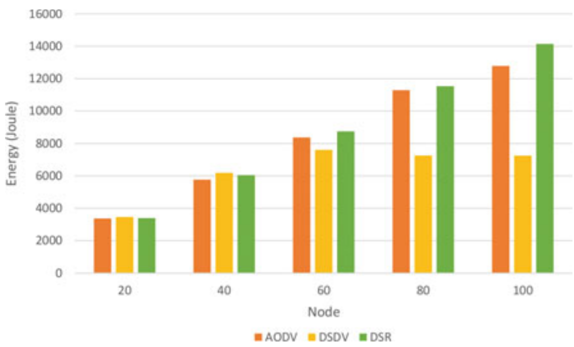


Fig. 10 Graph of residual energy against nodes from Model II

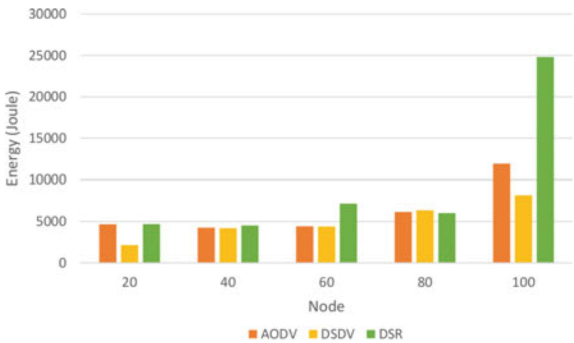


Fig. 11 Graph of residual energy against nodes from Model III

routing protocol because it has routing discovery. Figure 12 shows that the AODV protocol excels at 20 and 100 nodes. In comparison, the DSR protocol excels at 60 and 80 nodes. Then, the DSDV protocol excels at 40 nodes. The best RE value is in the DSR routing protocol because it has routing discovery. The same thing happened in the Manhattan grid mobility model, where UDP/CBR had a higher residual energy value than TCP/FTP due to the absence of re-checking the data that had been sent.

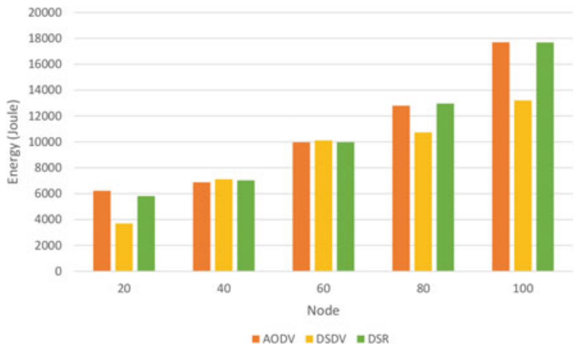


Fig. 12 Graph of residual energy against nodes from Model IV

4 Conclusion

The DSR routing protocol has better throughput performance and packet delivery ratio on any mobility models that use TCP/FTP traffic agents. The highest throughput value is 638.61 Kbps at 20 nodes of the random waypoints, and the highest packet delivery ratio is 99.91% at 100 nodes of the Manhattan grid.

The AODV routing protocol has better throughput performance and packet delivery ratio in every mobility model variation that uses UDP/CBR traffic agents. The highest throughput value is 85.04 Kbps in the 100 nodes of the Manhattan grid, and the highest packet delivery ratio is 99.93% in the 100 nodes of the Manhattan grid.

The DSR protocol has a higher residual energy value than the AODV and DSDV protocols. The highest residual energy value is at 100 nodes of random waypoint TCP/FTP with a value of 24798.73 J.

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References

1. Kumar S, Kumar CDS (2015) Study of manet: characteristics, challenges, application, routing protocol and security attacks. Int J 2
2. Jiatmiko N, Prayudi Y (2015) Simulasi jaringan manet dengan ns3 untuk membandingkan performa routing protokol aodv dan dsdv
3. Manapa ES, Sampetoding EAM, Lewakabessy G (2020) Potensi penggunaan mobile ad-hoc network (manet) sebagai alat komunikasi data pada transportasi di Indonesia. J Dyn Saint 4:865–868
4. Alamsyah A, Setijadi E, Purnama IKE, Purnomo MH (2018) Analisis kinerja protokol routing reaktif dan proaktif pada manet menggunakan ns2. Jurnal Nasional Teknik Elektro dan Teknologi Informasi (JNTETI) 7:138–143. [Online]. Available http://ejnteti.jteti.ugm.ac.id/index.php/JNTETI/article/view/414

5. Nurusshobah M, Trisnawan PH, Amron K (2019) Analisis kinerja protokol routing dynamic manet on-demand (dymo) dan cluster based routing protocol (cbrp) pada mobile ad-hoc network (manet). Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer e-ISSN 2548:964X
6. Gupta AK, Sadawarti H, Verma AK (2013) Performance analysis of manet routing protocols in different mobility models. Int J Inf Technol Comput Sci 5:73–82
7. Sharma R, Gupta K (2012) Comparison based performance analysis of udp/cbr and tcp/ftp traffic under aodv routing protocol in manet. Int J Comput Appl 56:28–35
8. Taufan B, Primananda R, Data M (2018) Analisis perbandingan kinerja protokol routing olsr dan dsdv pada manet berdasarkan pergerakan node. Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer. e-ISSNN 2548:964X
9. Appiah M (2017) Performance comparison of mobility models in mobile ad hoc network (manet). In: 2017 1st International conference on next generation computing applications, NextComp 2017, pp 47–53