Analysis of Quality of Service Routing Protocols AODV and AOMDV on MANET Using NS2

Alamsyah[1,2]
[1]Dept. of Electrical Engineering, Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia
[2]Dept. of Electrical Engineering, Universitas Tadulako Palu, Indonesia[2)]
alamsyah14@mhs.ee.its.ac.id

Eko Setijadi[1], I Ketut Eddy Purnama[3], Mauridhi Hery Purnomo[4]
[3,4]Dept. of Computer Engineering, Institut Teknologi Sepuluh Nopember (ITS) Surabaya, Indonesia
{ketut, hery, ekoset}@ee.its.ac.id

***Abstract*- One of the problems and challenges that occur in the mobile ad-hoc network (MANET) is a dynamically built topology system, without the support of existing infrastructure, and limited energy consumption. To overcome the problems of MANET, it needs a routing protocol scheme capable of producing the reliable quality of service (QoS) parameters. This study aims to analyze QoS of Adhoc On-Demand Distance Vector (AODV) and Adhoc On-Demand Multipath Distance Vector (AOMDV) based on node density. QoS parameters to be analyzed are packet delivery ratio (PDR), throughput, packet loss, delay, and routing overhead (RO). Simulation results performed using NS2 show that AODV has better performance on less dense nodes. For AOMDV has performed on the number of more dense nodes.**

***Keywords* — MANET, AODV, AOMDV, QoS.**

I. NTRODUCTION

MANET is a set of nodes that use wireless interfaces to communicate between one node and another node [1]. However, one of the problems and challenges that occur in MANET is a dynamically built topology network system, without the support of existing infrastructure [2] and the availability of limited energy sources [3]. The constantly changing and unpredictable movement of nodes [4] will inevitably lead to excessive packet delivery effects on each neighboring node. To ensure that packet delivery quality is successfully received at the destination node and does not cause redundant packets at each destination node, the selection of routing protocols is essential in the MANET scheme.

Some researchers have proposed MANET topics especially in analyzing the performance of reactive routing protocols, including analyzing the performance of reactive routing protocols (AODV, DSR) based on the number of nodes and node velocities. Simulation results performed using NS2 indicate that the performance of AODV is better than DSR on each additional number of nodes and node speed. DSR is only active on the number of nodes and the speed of smaller nodes [5]. However, the number of nodes used is still limited to 50 nodes.

Comparison of the performance of reactive routing protocols (AODV, DSR, and TORA) based on QoS parameters, such as PDR, throughput, and delay is proposed [6]. The simulation results performed using OPNET showed that AODV had better performance on each additional number of nodes, compared to DSR and TORA. However, the number of nodes used is still limited to 100 nodes. Analysis of the influence and performance of AODV, DSR and TORA routing protocols based on the number of nodes or node density proposed [7]. The results of the study using OPNET showed that AODV had better performance at each additional number of nodes, compared with DSR and TORA. For TORA protocol only better than RO side compared with AODV and DSR. However, the number of nodes used is still limited to 100 nodes.

The literature study of routing protocols AODV, DSR, and AOMDV based on PDR, throughput, RO and delay parameters is proposed [8]. The paper review results show that AODV has better PDR performance than AOMDV and DSR. An AOMDV has a better delay performance compared with AODV and DSR. However, the research did not completely explain the simulation parameters used by the AODV, DSR and AOMDV protocols.

The effect of the use of mobility model Random Way Point and Random Walk on AODV and DSR routing protocol based on PDR, throughput, delay and RO parameters using Network Simulator is proposed [9]. Simulation results show that DSR performs better compared with AODV when adding nodes. However, the number of nodes that are simulated is only 40 nodes.

The performance of the AODV routing protocol based on the number of nodes with parameters used such as PDR, RO and latency is proposed [10]. Simulation results using OMNET show that AODV has better PDR performance on 10 nodes and better RO performance on 50 nodes. However, researchers only focus on AODV research.

This study will analyze QoS of routing protocols AODV and AOMDV with varying nodes starting from 25 nodes up to 150 nodes. The QoS parameters used in analyzing routing protocols are PDR, throughput, packet loss, delay, and RO. Furthermore, the discussion of this paper organized as follows.

Part 1 deals with MANET issues, solutions for improving QoS in MANET, and research related to MANET routing protocols. Section 2 deals with routing protocols on MANET such as AODV and AOMDV. Part 3 discusses research methods. Part 4 presents the results of simulations and discussions. Part 5 discusses the conclusions of the research results obtained.

II. ROUTING PROTOCOLS ON MANET

Several methods have considered in the classification of routing protocols in MANET. The classification is based on network schemes and routing. Dynamic network topology changes require multi-hop communication systems and reliable routing schemes. So the routing factor is one of the essential aspects of the network.

The MANET routing protocol can group into three main sections based on the routing information update mechanism, [11] reactive, proactive, and hybrid routing protocols. The routing protocol on MANET can see in Figure 1.

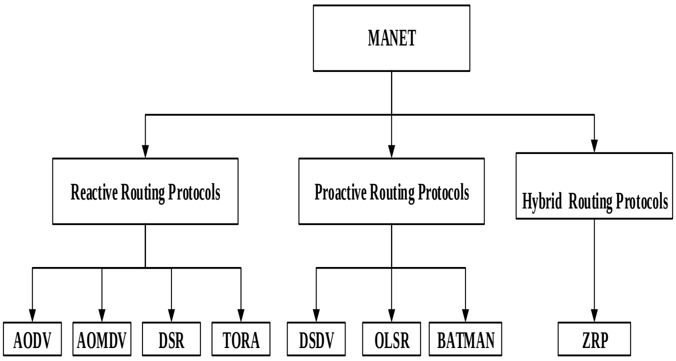

Fig. 1. Classification of routing protocols on MANET

Reactive routing protocols are routing protocols that work by forming a routing table if there is a request to create a new route link or link change. The research focus that will discuss in this paper is the reactive routing protocol consisting of AODV and AOMDV.

A. Routing Protocol AODV

AODV is a reactive routing protocol that uses traffic flow and topology in determining the route. AODV manages the latest routing information by using the route discovery procedure and the updated routing table [12]. A node considers the route as an active path, if it sends, accepts or passes packets to that route. In AODV, where the route discovery package is initiated and widely distributed only if there is a source that wants to contact the destination. Furthermore, the network topology changes should be sent only to the node that will need the information. But the AODV problem is not to support asymmetric relationships. That is, AODV is capable of supporting just symmetric connections between nodes, both of which are capable of transmitting each other's packets. AODV has a route discovery and route maintenance mechanism. Route discovery consists of route request (RREQ) and route reply (RREP). While routing maintenance in the form of Data, route update, and route error (RERR) [13]. The mechanism of route discovery, route update, and route error can see in Figure 2.

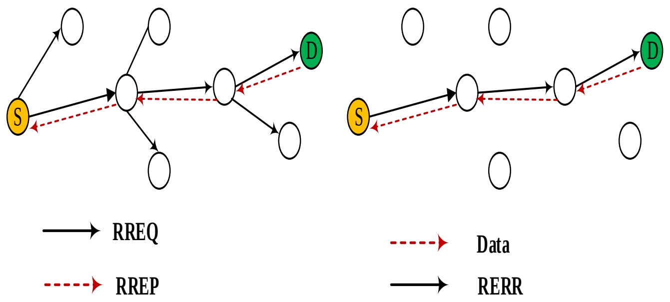

Fig. 2. (a) Route discovery dan (b) route maintenance

In Figure 2 shows the source node "S" transmits the RREQ message, while the destination node "D" transmits the RREP message to the entire "mobile" node network. The destination node "D" generates a RERR message when the pause runs between the source node "S" and the destination node "D".

B. Routing Protocol AOMDV

AOMDV is a reactive routing protocol which is the development of the AODV routing protocol to minimize the frequent failure of disconnected routes. AOMDV is vector-based and uses a hop-by-hop approach. In performing route searches using route discovery procedures [14].

The main difference between AODV and AOMDV lies in the number of routes found in each route search or route discovery. AOMDV in route search is unlike AODV which selects only one RREP, but on AOMDV each RREP will be considered by the origin node so that multiple paths can found in a single route search. To search for new routes will only be done if all the routes that have been found to fail. AOMDV has three advantages over another multipath routing: 1) AOMDV does not have high inter-node coordination overhead because communication on AOMDV is only done when needed just, 2) AOMDV guarantees an alternate route of disjoint or intersecting through distributed computing on each node without the need for computation from the source node only. So that the route found is not expected to happen loops, and 3) AOMDV calculate or find alternative routes with minimal overhead compared to AODV.

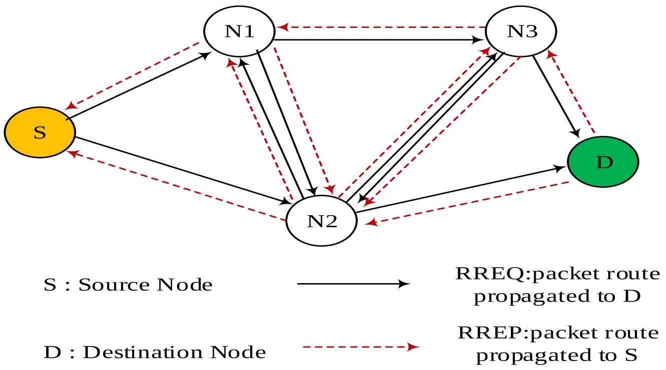

Fig. 3. Propagation of RREQ dan RREP in AOMDV

Figure 3 shows a process of AOMDV protocol stages in performing route discovery and route maintenance, as follows:

1. When S (source node) will communicate with the destination node, S will flood the route request (RREQ) packet to the network.
2. As a result of RREQ flooding the network, a node may receive multiple copies of the same RREQ.
3. At AOMDV, all RREQ copies are checked to make alternative reverse paths, but reverse paths are only created using RREQ copies that can maintain loop-freedom and disjointness starting from the source node.
4. When the intermediate node receives a reverse way through a copy of RREQ, it checks whether one or more valid destination paths. If there is, this node will create the RREP packet and send it back via a reverse path to the source node.
5. When the destination node receives a copy of the RREQ, the node will create an opposite track in the same way as the intermediate node does. However, the RREP generated by the destination designed with a more "free" rule. The point is that destination can send RREP via a loop-free reverse path without having to disjoint. RREP sending done to prevent "route cutoff" or route deleted due to suppressing or when a node must select one of two or more paths.
6. AOMDV uses the RERR (Route Error) package. A node will create or forward the RERR packet to the destination when the last way to the target broken. AOMDV also optimizes to save packets being communicated through broken links by resuming the packet via an alternate path.

III. RESEARCH METHODS

A. Research Stages

The research method used is a simulation-based research. The simulation program run in displaying QoS parameter results such as PDR, throughput, packet loss, delay, and RO using NS2 program (network simulator). The next stages of the research can see in Figure 4.

Stages of research can describe as follows:

1) Literature study: The study begins by looking for references related to the investigation studied. In particular, the material of the reactive routing protocols on MANET. In addition, supporting programs for network simulation such as NS2.

2) Designing a simulation model: Designing a simulation model will base on literature studies that have obtained. The design of the simulation model includes: the area of the simulation, the antenna model used, the mobility model used, the packet size, the number of nodes, and the simulated motion model.

3) Simulation: The simulation model used in this study is a simulation model that adapts to the characteristics of the actual conditions. The simulations used in this study are NS2 version 2.35 [15] and performance analysis using AWK script [16]. NS2 is an open source based simulation program developed with an open-source license.

4) Analysis of simulation results: Simulation results in the form of file extension (* .tr) and visualization of the simulation results in the form of file extension (* .nam). For PDR parameters, throughput, packet loss, delay, and RO can see in the file extension (pdr.awk). Analysis of simulated data generated made in program Matlab.

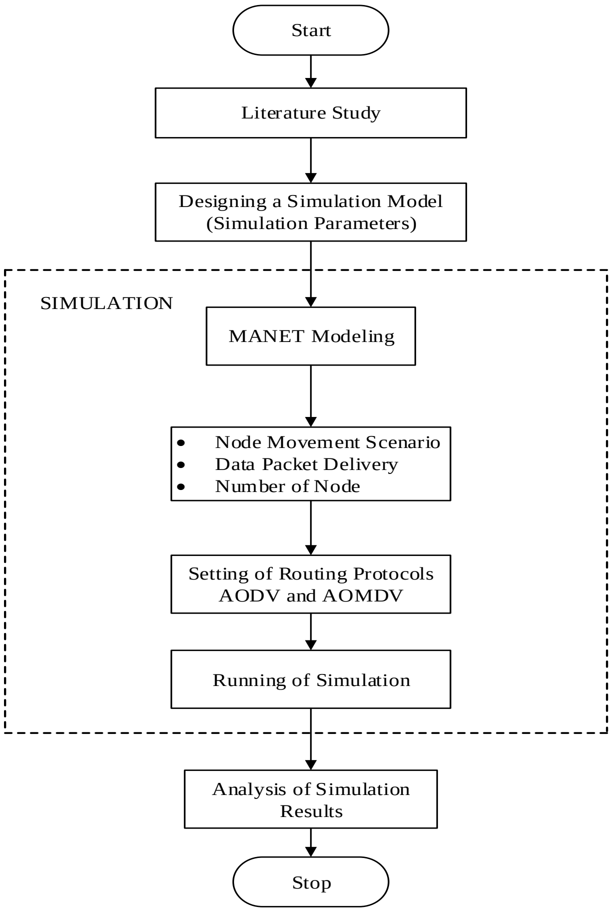

Fig. 4 Research flowchart

B. Simulation Parameters

The simulation parameters used in this study are routing parameters. This routing parameter will adjust according to the characteristics of each routing that will apply. The simulation parameters used in this study can be seen in Table 1.

TABLE I
SIMULATION PARAMETERS

Parameters Name	Description
Simulator	NS 2.35
Operating System	Ubuntu 14.04
Routing Protocols	AODV, AOMDV
Number of Node	25, 50, 75, 100, 150
Radio Propagation Mode	TwoRay Model
Transport Protocol	UDP
Packet Size	512 bytes
MAC Protocol	IEEE 802.11
RTS/CTS	None
Mobility Model	Random Motion Model
Simulation Time	200 seconds

The area of the scenario used for the simulation is the size of 500 meters x 500 meters. The propagation model used in the NS2 simulation is the TwoRay model [17], and the mobility model is the Random Motion model. The simulation scenarios used based on the change in the number of nodes in each experiment with the number of nodes varying starting from 25 nodes to 150 nodes.

IV. RESULT OF SIMULATION AND DISCUSSION

To evaluate and analyze QoS of routing protocol AODV and AOMDV on MANET used NS2 simulation. The next, parameters to be analyzed are PDR, packet loss, throughput, delay, and RO.

The number of nodes used in the simulation is varied, starting from 25 nodes to 150 nodes and a maximum speed of 20 m / s. Determination of performance results of the AODV and AOMDV routing protocols is performed based on the number of node additions or node density levels.

A. *Packet Delivery Ratio*

Figure 5 shows that PDR performance based on the number of node densities. The movement of PDR values at 50 nodes to 150 nodes for AOMDV is likely to be stable. For AODV tends to be unstable. The simulation results show that AOMDV has a better average PDR performance compared to AODV. The increased the PDR on AOMDV for more densely packed nodes, especially at 100 nodes up to 150 nodes due to AOMDV ability to successfully reduce the disconnected route. However, the average PDR value for AODV is still better than AOMDV. The PDR percentage for AODV of 36.04% and AOMDV of 34.98%.

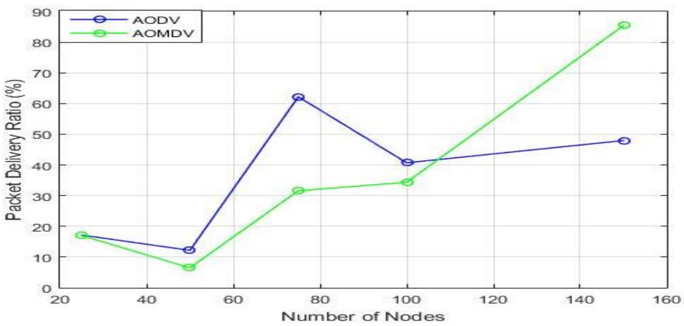

Fig. 5. Results of simulation PDR

B. *Throughput*

Figure 6 shows the throughput performance based on the number of node densities. The movement of throughput values at 50 nodes up to 150 nodes for AOMDV is likely to decrease. For AODV tends to increase in more dense nodes, especially at 100 nodes up to 150 nodes. So the performance of AODV has a better throughput rate than AOMDV. The average throughput value for AODV of 275.1 Kbps and AOMDV of 235.8 Kbps.

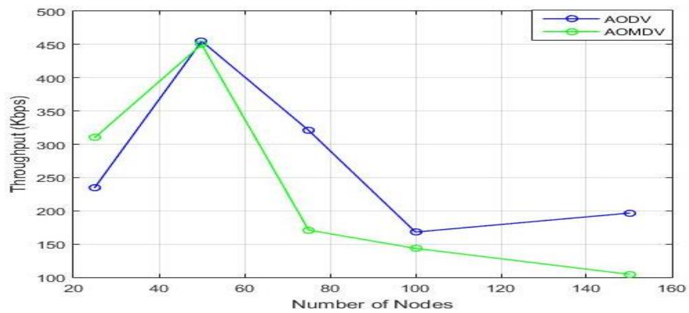

Fig. 6. Results of simulation throughput

C. *Packet Loss*

Figure 7 shows the performance of packet loss based on the number of node densities. The movement of packet loss values at 50 nodes up to 150 nodes for AOMDV is likely to decrease, whereas AODV tends to be unstable. However, the performance of AODV has an average packet loss better than AOMDV. The average packet loss value for AODV of 63.96% and AOMDV of 65.02%.

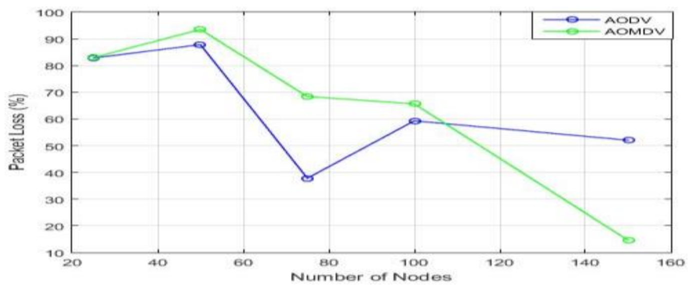

Fig. 7. Results of simulation packet loss

D. Delay

Figure 8 shows the delay performance based on the number of node densities. Movement of delay values at 25 nodes to 150 nodes for AODV and AOMDV is likely to decrease as the number of nodes increases. However, AOMDV performance has a better delay d compared to AODV. The average delay value for AOMDV is 31.63 milliseconds, and AODV is 40.57 milliseconds.

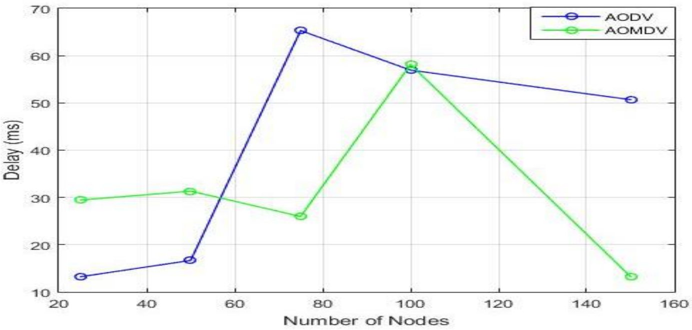

Fig. 8. Results of simulation delay

E. Routing Overhead (RO)

Figure 9 shows RO performance based on the number of node densities. The movement of RO values at 25 nodes up to 150 nodes for AODV and AOMDV is likely to be unstable. However, the performance of AODV has an average RO better than AOMDV. The RO average value for AODV is 13678.8 packets, and AOMDV is 155621.8 packets.

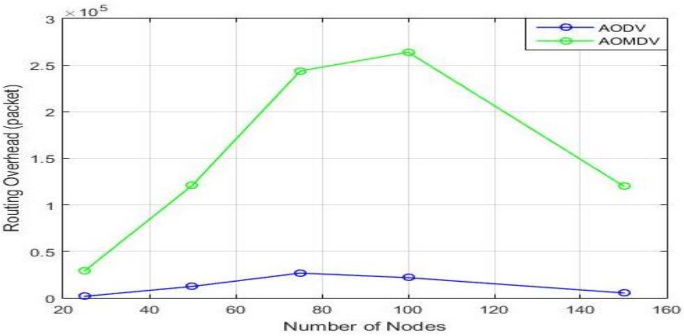

Fig. 9. Results of routing overhead

V. CONCLUSION

Simulation results based on the number of node densities indicate that AOMDV performs better than AODV on more denser nodes regarding parameters such as PDR, throughput, packet loss, and delay. For non-dense nodes especially 25 nodes up to 100 nodes, where AODV performs better than AOMDV of all parameters.

So it can be concluded that AOMDV is very supportive for more dense networks, while AODV is very supportive of networks that are not dense.

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