Performance Comparison of Modified AODV-ETX with AODV and AODV-ETX Routing Protocol in an MANET

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Abstract. Expected Transmission Count (ETX) is one of the many metrics developed in the ad hoc routing protocol. Most research, studied on modified AODV-ETX by varying the value of MY ROUTE TIMEOUT (MRT) and ACTIVE ROUTE TIMEOUT (ART) values in the RREQ and RREP packet headers. Those studies resulted the optimum value of MRT and ART was 80 seconds. These results has not shown optimal performance of AODV and AODV-ETX. This paper discusses performance comparison of modified AODV-ETX with AODV and AODV-ETX on MANET. The result is that the throughput on the modified AODV-ETX has increases 5.72 %, PDR increases 5.80 %, 4.31 % overhead reduction, 10.19 % increase on end to end delay, and 3.09 % increase on route discovery process.

1. Introduction
Mobile ad hoc network (MANET) consists of independent nodes. A node can communicate with each other without the presence of a network infrastructure. A node can function as a transmitter and receiver as well as a router [1]. MANET was developed to reduce cable infrastructure and support for mobile communications. The problems is when one of node moves outside the transmission range of another nodes, the link can be broken so that it will affect the quality of video stream, video surveillance, and streaming of data. The Internet Engineering Task Force (IETF) has standarized two types of routing protocols on ad hoc networks that is reactive types, e.g. AODV, DSR, TORA, and proactive types, e.g. DSDV, WRP, GSR, CGSR [2]. Both types of protocols each have their strengths and weaknesses.

This paper focussed on ad hoc On Demand Distant Vector (AODV) protocol. AODV protocol is a routing protocol in ad hoc networks which uses hop count as routing metric. The AODV protocol has more minimal overhead compared to the type of proactive protocol [3] and has better energy efficiency compared to the type of proactive protocol and other reactive protocols [4]. The metric that is widely used in ad-hoc networks is the hop count, because it is the most convenient and simple.

The metric hop count selects the path that has the smallest number of hops even though other paths with a larger number of hops offer greater throughput [5]. One of the approaches to overcome this
problem is to replace the hop count metric with Expected Transmission Count (ETX). ETX metric is a new route metric for finding high-throughput paths in multi-hop wireless networks. The ETX of a path is the expected total number of packet transmissions (including retransmission) required to successfully deliver a packet along that path [6]. The path with the minimum ETX value is the path with the largest throughput value. AODV-ETX is a modified AODV protocol with ETX metric [7].

The AODV protocol has MY ROUTE TIMEOUT (MRT) and ACTIVE ROUTE TIMEOUT (ART). MRT is the life time of the reverse lane and ART is the life time of the forward lane. If the reverse and forward paths stored in the routing table are not used during the MRT and ART times, the reverse and forward paths will be removed from the routing table and the route discovery process will be repeated if a route is needed again. If the reverse path and forward path are stored in the routing table, then MRT and ART will be updated. The time set on MRT and ART will affect the route discovery process. Another paper wrote the results of tuning the value of MRT and ART on the AODV-ETX protocol in MANET. The results obtained by the MRT and ART 80s results in a stable AODV-ETX Protocol performance [8]. We have not found another paper that provides information on improving the performance of the AODV protocol by modifying the MRT and ART 80s values. The solution proposed in this paper is to compare the performance of the AODV-ETX protocol that has been modified, called the AODV MRT ART 80s with the AODV and AODV-ETX protocols.

2. Experimental

Performance testing simulations are carried out using the Network simulator (NS2 version 2.35). Other supporting devices include: Gedit, setdest, NS2 Scenarios Generator 2 (NSG2), Cbrgen, NS2 Trace Analyzer and AWK script. MANET is simulated by making a topology consisting of 25 nodes that move randomly at a speed of 1.38 m/sec in an area of 1500 m x 300 m and a simulation time of 300 seconds shown in Table 1. To get a different pattern of movement, it is tested with a different pause time. Different pattern of movement obtained by testing with a different pause time. Different pattern of movement obtained by testing with a different pause time.

| Parameter                          | Value                      |
|------------------------------------|----------------------------|
| Channel type                       | Wireless channel           |
| TX Power                           | 0.28 W                     |
| TX dan RX Gain                     | 1 dB                       |
| Posisi antenna dari tanah          | 1.5 m                      |
| Propagation model                  | shadowing                  |
| MAC layer                          | IEEE 802.11b               |
| Routing protocol                  | AODV, AODV-ETX, AODV MRT ART 80s |
| Traffic type                       | UDP                        |
| Application type                   | CBR                        |
| Number of transmiter and receiver node | 1                         |
| Packet size                        | 1000 byte                  |
| Packet interval                    | 0.005 s                    |
| Simulation time                    | 0-300 s dan 300 s          |
| Number of nodes                    | 25                         |
| Transmission range                 | 250 m                      |
| Movement models                    | Random Way Point           |
| Node Speed                         | 1.38 m/s                   |
| Pausetime                          | 0 s, 1 s, 5 s, 10 s, 20 s, 30 s |
| Probe interval                     | 1 s                        |
| Probe window                       | 10 s                       |
| Area                               | 1500 m x 300 m             |
| Location                           | Outdoor                    |
A small pause time reflects a constant node movement. Contrarily, a large pause time reflects the movement of nodes that tend to be idle. By changing the pause time value, different node movement patterns could be obtained even though they use the same speed shown in Figure 1.

![Figure 1. MANET in simulation](image)

To determine the performance of all protocols, the throughput, end to end delay and routing overhead, packet delivery ratio (PDR) and total route discovery processes are measured and compared.

### 3. Results and Discussion

From the tests that have been done, a comparison of the performance of all protocols had been concluded. In this paper, the AODV modification protocol is named AODVETX MRT = ART80s.

Different pause time values is not part of this research. its is just to make different simulation conditions.

#### 3.1 Throughput

This is the total data packet received by the recipient from the sender, calculated in kbps [9]. In Figure 2, if the performance of AODV-ETX MRT = ART 80s = 80s compared to AODV-ETX performance, the average throughput in AODV-ETX MRT = 80s ART = 80s increases = 5.72 %. Compared with AODV, the average throughput increases = 15.84 %.
3.2 end to end delay
End to end delay is the time needed for the package to be sent until the package is received and recognize the packet sender [9]. In Figure 3, the average end to end delay performance of AODV-ETX MRT = ART 80s = 80s compared with the AODV-ETX has increased = 10.19 %. Compared with AODV, the average end to end delay is increased 30.65 %.

3.3 packet delivery ratio (PDR)
PDR is the ratio between the packet that was successfully received by the destination and the packet sent by the source [10]. In Figure 4, the average PDR performance of AODV-ETX MRT = ART 80s = 80s compared to the AODV-ETX has increased = 5.80 %. Compared with AODV, the average PDR has increased by 15.87 %.
3.4 Routing overhead

Routing overhead is the total routing package proportional to the number of packets received by the recipient. This routing overhead can be obtained by calculating the number of routing packets divided by the number of packets received by the receiver [9]. In Figure 5, the average routing overhead performance of AODV-ETX MRT = 80s ART = 80s compared to AODV-ETX has decreased = 4.31 %. Compared with AODV, the average routing overhead is increased by 28.34 %.

3.5 Total process route discovery

Total process route discovery is how often routing protocols do route discovery processes. In Figure 6, If more of route processes discovered then the routes are often disconnected. The average route discovery performance of AODV-ETX MRT = 80s ART = 80s compared to the AODV-ETX, has increases = 3.09 %. Compared with AODV, the average route discovery process on MRT = 80 seconds ART = 80 seconds decreases = 8.94 %.
Figure 6. Comparison of route discovery processes

4. Conclusion
The conclusion of this study is that the modification of the AODV-ETX protocol by applying the MRT and ART values of 80s increases throughput by 5.72 %, increasing PDR by 5.80 %, decreasing routing overhead by 4.31 %, but has an increase in end to end delay of 10.19 % and a route discovery increase of 3.09 % compared to the AODV protocol.

References
[1] Roy R 2010 Handbook of mobile ad hoc networks for mobility models (New York: springer)
[2] Raut, Surendra H, Ambulgekar H P 2013 Proactive and Reactive Routing Protocols in Multihop Mobile Ad hoc Network LIARCSSE 3 152–7
[3] Richard C, Perkins C E, and Westphal C 2015 Second Annual IEEE Communications Society Confl. on Sensor and Ad-Hoc Communications and Networks (California:IEEE)
[4] Gouda B S, Dass A K, and Narayana 2013 K.L. IEEE Autom. Comput. Commun. Control Compress. Sens. Imac4s (Kottayam: IEEE) 306 – 312.
[5] Dubey V and Dubey N 2014 Performance evaluation of AODV and AODVETX Proc. - 2014 6th Int. Conf. Comput. Intell. Commun. Networks, CICN 2014 482–5
[6] Liu S, Wu M, Chen C, Lv B and Li S 2013 A High-Throughput Routing Metric for Multi-Hop Ad hoc Networks based on Real Time Testbed 2013 IEEE International Conference of IEEE Region 10 (TENCON 2013) (Xi’an, China: IEEE) pp 4–7
[7] Hatti S, Kamakshi M.B 2013 Springer 131 817-826
[8] A Purnomo, Widyaqwan, W Najib, R Hartono and Hartatik 2018 IOP Conf. Ser.: Mater. Sci. Eng. 333 012107
[9] Rohal P, Dahiya R, and Dahiya P 2013 LIARET 1 54-58
[10] Lee S J and Gerla M. 2000 WCNC (Chicago: IEEE) 1311-1316