Performance Study of Wireless Access in Vehicular Environment 802.11p in Ad-Hoc on Demand Distance Vector Routing (AODV) with Propagation Models Nakagami and Two Ray Ground

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***Abstract*—The development of communication systems is not only limited in its use for human interaction and mobility with various electronic devices. However, it is expected to be a solution for traffic management and management strategies. The number of vehicles is continuously increasing especially in big cities so it needs communication between vehicles for the development of VANETs technology. The IEEE international standards communication system establishes the use of the Wireless Access in Vehicular Environment (WAVE). With the IEEE 802.11p standard, it is possible to build an integrated information and communication-based transportation system.**

In this research will be analyzed VANET communication performance through parameters of packet delivery ratio, routing overhead, and packet drop. VANET uses NS-2 as a simulator and AODV routing protocol. In a network, routing protocols are very influential on VANET network performance. Simulation scenarios with VANET using Nakagami and TwoRayGround propagation models are expected to result in connectivity performance on interoperable communication networks (V2V) with IEEE 802.11p standards in VANET environments. From the experimental results in the AODV protocol scenario using propagation modeling, the value of packet delivery ratio, routing overhead, and packet drop with the Nakagami transmission model is better than the value of packet delivery ratio, routing overhead, and packet drop with TwoRayGround transmission model has good value but Unstable in the node transmission process. Thus, the performance of the Nakagami transmission model looks more stable overall than the TwoRayGround transmission model.*

***Keywords*—802.11p, Nakagami, TwoRayGround, AODV, NS-2.**

I. INTRODUCTION

The number of vehicles continues to increase especially in big cities so that, required good connectivity and communication between vehicles to exchange information. VANET is expected to be a solution to traffic management and engineering strategies. For the development of VANETs technology, IEEE sets out the use of an international standard communication system called Wireless Access in Vehicular Environment (WAVE). With the IEEE 802.11p (WAVE) standard, it is possible to build an integrated information and communication-based transportation system. Currently, the communication system between vehicles is one of the wireless communication systems has experienced a fairly rapid development. WAVE is a standard that is focused on the exchange of information through communication between vehicles. The IEEE 802.11p protocol is a standard for the operation of the physical layer (PHY) and part of the data link layer (MAC) [1].[2] proposed an approach with TwoRayGround to analyze the behavior of routing protocols on VANETs. In a routing protocol, it is very influential on network performance.

The problems presented above then the researchers proposed a performance that analyzes routing protocols that will model the performance of wireless networks using the Nakagami and TwoRayGround propagation models. Both models are required in the simulator to calculate the signal strength of transmission and fading which causes decreased transmitter performance on the wireless network at the receiving station. The mobile communication system scheme is used to predict the next mobile position of the simulated unit using the NS2 simulator.

II. EXPERIMENTAL

A. Platform Environment

Based on the above test criteria, a trial is performed that produces a file containing mobility and varying positions on each node.

TABLE 1.
TESTING CRITERIA

Criteria	Specification
Number of Nodes	10, 50, 100
Max Speed Node (m / s)	15
Experiment	5 files per number of nodes
Initial Position of Node	Random

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Output	.*tcl

B. Parameter Standar Dedicated Short Range Communication

The mobility generation scenario is generated by generating file movement of nodes that tools already exist on the NS-2 which will produce output in .tr* form and used in Tcl file during simulation on the NS-2 as a form of moving node move.

TABLE 2.
PARAMETER STANDAR DEDICATED SHORT RANGE COMMUNICATION

Parameter	Range
Frequency Spectrum	5.850-5925 GHz
Data rate	75MHz
Maximum Distance Reach	6 Mbps-27 Mbps
Minimum Reach Distance	1000m
Channel Capacity	7 channel
Downlink Power	33 dBm
Uplink Power	33 dBm

C. Parameter Standar simulation VANET

The simulation is done by using Network Simulator software version 2.35. In designing the NS-2 code with the VANET configuration, a mobility scenario is combined with the TCL script generated during scenario creation. The simulation parameters are determined based on the standards used in the VANET network, table 3.2 shows the parameters varied in this simulation.

TABLE 3. PARAMETER STANDAR SIMULATION VANET

Parameter	Range
Number of Nodes	10,50,100
Channel Type	Wireless
Routing Protocol	AODV
Mac Type	802.11p
Source of Traffic	Constant Bit Rate (CBR)
Packet Size	512 byte
Network Simulator	NS-2
Simulation Environment	Urban
Propagation model	-tworayground - Nakagami
Speed	5,10,15 m/s

D. Matriks Analysis

The main focus in the analysis is to measure the performance of AODV routing with multiple matrices of analysis ie Packet Delivery Ratio (PDR), Routing Overhead and Drop packet delivery. Packet Delivery Ratio is calculated from the comparison between packets sent with received packets. Packet Delivery Ratio is calculated using Equation , where received is the number of received data packets and sent is the number of data packets sent.

$$PDR = \frac{received}{sent} \times 100 \tag{1}$$

Drop Packet is the number of packets that do not reach the destination that can be obtained through Eq. (3-2) as follows.

$$\text{Drop Packet } = \frac{packet_{sent} - packet_{received}}{packet_{sent}} x\ 100\% \tag{2}$$

Routing overhead is the number of packet control packets transmitted per packet data sent to the destination during simulation. The transmitted routing packets consist of RREQ, RREP, and RERR. The formula of routing overhead (RO) can be seen in Equation below is as follows.

$$RO = RREQ_{sent} + RREP_{sent} + RERR_{sent} \tag{3}$$

The test results in running the simulation program the packet transmission rate scenario for each of the analysis matrix is Trace File.

E. Test and Evaluation Scenarios

To evaluate the performance of IEEE 802.11p we use two simulation tools: mobility generator SUMO and VanetMobiSim and NS-2 for model simulation of the vehicular network. The first thing to do is to model the performance of wireless network channels or channel sets to calculate the signal strength of transmissions at the receiving station. Then it detects the movement of the vehicular node with the mobility simulation tool. The performance of wireless channels is calculated based on the parameters of VANET. The modeled parameters describe the NS-2 simulation tool and analyze the results of the analytical metrics used to implement the performance of IEEE 802.11p.

F. Analysis Packet Delivery Ratio

Based on Table 4 and graph in Figure 1 it can be analyzed that the matrix performance of Packet Delivery Ratio of the AODV routing protocol on the Nakagami propagation model (blue line) is better than the AODV routing protocol in TwoRayGround (orange line). The test results of the calculated average values are grouped into the following table.

The PDR values obtained for both ranged from 50% - 95%. If packet delivery is reduced, then the value of the PDR increases as the packet sent is balanced by the number of nodes or vehicles, resulting in more successful packet delivery. TwoRayGround propagation model performance decreased when the node or vehicle amounted to 100 that is the difference value of 11.7.

A very significant change in value occurred at the time the node amounted to 10 performances from TwoRayGround increased by about 35.3% when compared with Nakagami only increased by 19.3%. However, this performance can be better depending on the number of moving nodes. At the number of nodes or vehicles around 100 about TwoRayGrond decreased approximately by 11.7% difference while the performance value of Nakagami decreased performance by about 1.7%. So the performance of Nakagami propagation model is stable along with the increasing number of vehicles or nodes. Reduced performance of the AODV protocol for each propagation model may be caused by disconnection of communication between the surrounding vehicle and the receiving antenna distance due to the smaller node delivery.

TABLE 4.
ANALYZE PACKET DELIVERY RATIO SCENARIO NS-2

Number of nodes or vehicles	TRG	Nakagami
10	55.2	73.7
50	90.5	93.0
100	78.8	91.3

G. *Analysis Routing Overhead*

In AODV protocol performance testing using TwoRayGround and Nakagami done by varying the number of nodes this shows that the value of Routing Overhead on Nakagami and TwoRayGround significantly increased steady and sharp increase as the number of vehicles in the simulation increased (see table 5 and figure 2).

Based on a table and above graph can result of analysis of overhead routing indicate that in addition number of node or vehicle 50 for both model propagation have stable increase. In Figure 4.12 a very significant change of value also occurs when the node is 100, Nakagami's propagation model increases About 1857.6 for TwoRayGround propagation models experienced a sharp and significant increase in a margin of about 3860.8. The increase in routing overhead performance on Nakagami tends to be better than TwoRayGround.

The movement of the node during packet delivery causes the value of Routing Overhead in the AODV routing protocol for Nakagami propagation model is more stable although it does not experience a sharp increase as in TwoRayGround is due to the transmission of data packets between node 1 to node 0 faster completed for one packet delivery and not There is a forwarded packet.

TABLE 5.
ANALYZE ROUTING OVERHEAD SCENARIO NS-2

Number of nodes or vehicles	TRG	Nakagami
10	190.4	191.0
50	1412.4	1416.2
100	5273.2	3273.8

H. *Analysis Data Packet Drop*

The results of the analysis performed on the above metrics led to differences between the two propagation models, namely TwoRayGRound and Nakagami. Factors that cause this discrepancy refers to the spread of packet transmit and the movement of nodes that occur. Packet Drop affects both PDR and RO matrices because the more packets drop the PDR value will be lower. The higher RO value than the lower packet drop due to faster route search is done as the number of nodes increases. Disconnection of communication between vehicles in the network can lead to a larger drop package.

Packet drop affects the analysis results of both propagation models at the packet transmission rate as the number of nodes 50, TwoRayGround experiences an increase in packet drop value by a margin of 39.6 compared to Nakagami having a sharp rise at the node of 50 with a difference of 66. Further changes occur when the addition 100 nodes, TwoRayGround has increased by a margin of 248.6. However, when compared with the Nakagami propagation model, the difference between 87,6 is better than TwoRayGround, so the dropped package is getting smaller.

Here is the average Packet Drop value that occurs when the Trace File script counters in the NS-2 simulation.

TABLE 6.
ANALYZE PACKET DROP SCENARIO NS-2

Number of nodes or vehicles	TRG	Nakagami
10	110.2	68.6
50	149.8	134.6
100	398.4	222.2

III. RESULTS AND DISCUSSION

In this section we will discuss the tests that have been conducted on the NS-2 scenario that was created. Testing functionality is divided into several test scenarios.

A. *Network Simulator 2*

Based on the above test criteria, a trial is performed that produces a file containing mobility and varying positions on each node. The results are then fed into the NS-2 simulator for the implementation of the AODV routing protocol, so that Trace Files will be obtained about the routing packets that occur between the nodes.

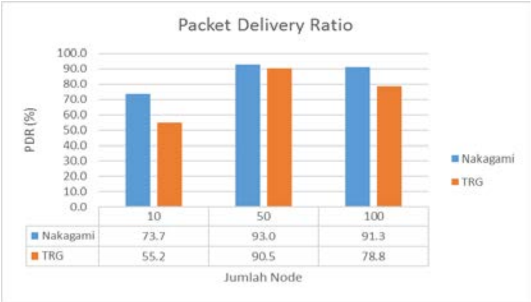

Figure 1. Graph Packet Delivery Ratio model propagation TRG and Nakagami.

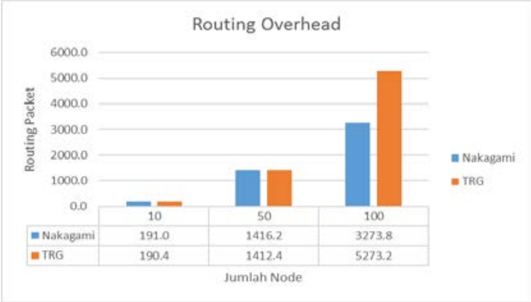

Figure 2. Graph Routing Overhead model propagation TRG and Nakagami.

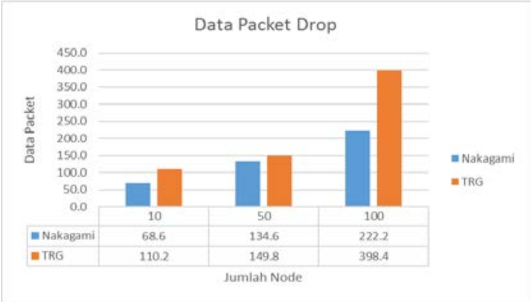

Figure 3. Graph Data Packet Drop model propagation TRG and Nakagami.

IV. CONCLUSION

From the experimental results in the AODV protocol scenario, we get the value of PDR, RO and PD with Nakagami transmission model better and better than the value of PDR, RO and PD with TwoRayGround transmission model so that the performance of Nakagami transmission model looks more stable overall than TwoRayGround transmission model.

After performing a performance study on the analysis of the effect of AODV Routing Protocol Performance, the value of PDR, RO and PD with Nakagami transmission model is better and better than the value of PDR, RO and PD with TwoRayGround transmission model so that the performance of the Nakagami transmission model looks more stable overall than the transmission model TwoRayGround.

This research needs to pay more attention to map processing of OSM map for mobility of SUMO and VanetMobisim genarator.

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REFERENCES

[1] M. Driss LAANAOUI and P. Said RAGHAY, “Routing Protocol in Urban Environment for V2V communication outing Protocol in Urban Environment for V2V communication Vanet,” *IJCSI Int. J. Comput. Sci.*, vol. 10, no. 1, pp. 210–214, 2013.

[2] S. A. Hosseini Tabatabaei, M. Fleury, N. N. Qadri, and M. Ghanbari, “Improving Propagation Modeling in Urban Environments for Vehicular Ad Hoc Networks,” *IEEE Trans. Intell. Transp. Syst.*, vol. 12, no. 3, pp. 705–716, Sep. 2011.