PERFORMANCE ANALYSIS OF DSDV ROUTING PROTOCOL VANET WITH TRANSMISSION RANGE, SPEED AND NODE DENSITY EFFECT ON FREEWAY MOBILITY

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***Abstract*— VANET is seen as promising approach towards an Intelligent Transportation System (ITS). The network was able to avoid and reduce the number of accidents that still happen often. DSRC is a wireless technology that is developed to support the communication between vehicles and between vehicles and infrastructure in a very dynamic network. A general transmission range hasn't been specified by the standard though a transmission range up to 1 kilometer has been proposed. There hasn't been a comprehensive study towards the performance of IEEE 802.11p MAC protocol that consider transmission range with different speed and node density, specifically on V2V communications where the nodes in the network are highly mobile. Research towards the performance of a highly mobile network is very important to understand the connectivity between nodes when disseminated data. Therefore, the research will study the performance of a highly mobile vehicular network with changes in transmission range, vehicle speed, and vehicle density.**

It can be concluded that the transmission range changes affect the performance of the VANET network that use DSDV routing protocol. At low density the farther the transmission range used then the value of QoS parameters will tend to improve. But as the density increases, farther transmission range could also degrade the QoS parameters. As node speed becomes faster in the network QoS parameter values are likely to worsen. It is also found that the value of the QoS parameters on the network at higher nodes speed is worse compared to QoS parameter value on network at lower nodes speed.

Keywords*— *VANET, DSDV, QoS, Transmission Range, Node Speed and Density

I. INTRODUCTION

In recent years, vehicles network have been fascinate many authority research and automotive industries. Vehicle network appearing to wireless networks that arises because the newest advances in wireless technology. Vehicular Ad hoc Networks or called as VANET can organizes the network itself and builds high mobility from moving vehicle. It is a part of class in Mobile Ad hoc Networks (MANET) [8]. The communications between vehicles are called intelligent transportation system (ITS) [7]. Currently VANET be one promising approach to a smart transport systems or intelligent transportation system [13].

The technology has been developed to perform such communications known as Dedicated Short Range Communication (DSRC). DSRC is a wireless technology that was developed to support communication between the vehicle (V2V) and vehicle with infrastructure (V2I) in a very dynamic network. The transmission range of the common has not been specified by the standard even though it has been suggested the transmission range up to 1 kilometer.

The transmission range is one of the challenges in vehicular networks. So far, there has been no comprehensive study on the performance of the IEEE 802.11p MAC Protocol are noticing the difference in the speed of the transmission range and density of nodes, especially on V2V communication where nodes in mobile networks. Research on network performance in conditions of high mobility is very important to understand the connectivity between vehicles in terms of dissemination of data. Therefore, in this study will look at the performance of vehicular network in high mobility with changes to the transmission range, the vehicle density, and speed of the vehicle.

II. OVERVIEW

A. ONE Simulator

In essence, ONE Simulator is a discrete event-driven simulation tool. At each step of the simulation tool update that implements a number of capital simulation main function [1].

The main function of ONE simulator is a model node movement, inter-contact nodes, message and routing handling. The analysis and collection of results completed passes through visualization details, reports simulation and post processing tools. Elements and interactions described in simulator. Description detail can be found in [2] and the project page [11] where there is also the source code.

The movement of the model implemented by node movement. This is a good model of synthetic or movement. Connectivity between nodes based on their location, and about communication range and bit-rate. Routing function is implemented by the module which determines routing messages to be passed through contact. Finally, the message can be generated by the generator. The unicast message always have a single source and destination host in simulation.

The results of the simulation are collected through the reports that are generated by the reports module to run a simulation. Report modules receive event (for example, message or event connectivity) of the simulation engine and generate results based on the event. The results can generate log event which is then further processed by other external post processing tool, or may be the result of statistical aggregates that are calculated simulator. And then, the graphical user interface (GUI) displays the visualization of the simulation state showing the location of active contacts and messages, carried by the node.

B. Network Simulator 2

Network Simulator 2 is a simulator that can works in UNIX type of operating system. NS2 is a tool for simulation of events both for doing a research in the field of network and provides necessary support for simulation of routing, multicast protocols, IP protocols, etc. NS2 has many advantages that will help the researches to do a project of simulation. The advantages of this, include support for multiple protocols and the ability to represent data - network data in graphical form. Then, NS2 also supports various routing algorithms and queuing algorithms [8].

C. VANET

Vehicular Ad hoc networks (VANET) is a subclass of Mobile Ad-hoc Network (MANET) where the vehicle is moving at high speed is the node that is used for the exchange of data in the network. In this environment the vehicle can move anywhere, any direction and with different speeds make a frequent moves in topology and network mobility patterns VANET serving the main difference of MANET. Today all major vehicle manufacturers and industry focus in this area to reduce the problem of communication between vehicles. Many researchers have contributed their research in this area such as Carnet, CarTALK 2000, DRIVE, FleetNet and COMCAR PROJECT. Routing protocol performance degradation with the speed and size of the network, so that the design of an efficient routing protocol is always challenging in an environment of high mobility and this is a major feature of VANET. In the network for data exchange the whole VANET mobile nodes behave as a router to the source or destination node [11].

D. Model Mobility Freeway

The mobility model of Freeway generally describe a model of mobility vehicle on the freeway or commonly referred to as a toll road. The model of mobility is a major road with a different direction. Any way it can, there is more than one lane as the way of the Express way. The movement of vehicles on this freeway mobility models is limited only at the lane the vehicle is running and there is no random movements that occur [5].

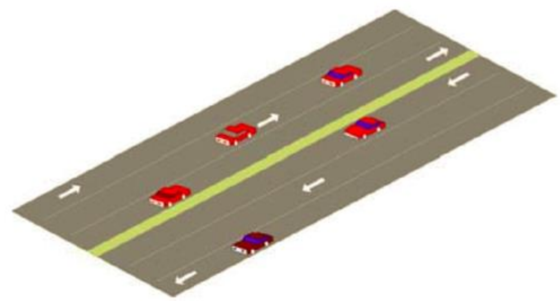


Figure 1. Freeway mobility

E. Destination Sequenced Distance Vector

This proactive routing protocol, i.e. DSDV, designed for use on IEEE 802.11 standards family. Destination sequenced distance vector (DSDV) adapted from conventional protocols routing information protocol (RIP) that can be used in ad hoc networks. DSDV adds new attributes, sequence number, on each entry in the routing table of RIP. Using the sequence number, mobile node can distinguish routes that are out of date from other routes so as to prevent the occurrence of the formation of the nonprofit route loop [1].

F. Transmission Range

In a vehicular network, the location of a node will become an important property. Long distance communication involving vehicles on the roads will be affected by the transmission range. Therefore there is some transmission range can be a reference point and corresponds to the power they are given. The following table of correspondence from the transmission range [6].

Transmission Range (m)	Transmission Power (dBm)
0 - 9	-20
10 - 49	-12
50 - 100	-5
101 - 125	-3
126 - 149	1
150 - 209	4
210 - 299	6
300 - 349	10
350 - 379	12
380 - 449	14
450 - 549	17
550 - 649	20
650 - 749	24
750 - 849	27
850 - 929	29
930 - 970	31
971 - 1000	32
> 1000	N/A in DSRC

Figure 2. Correlation transmission range with transmission power

III. SIMULATION PROCESS AND PARAMETER

VANET network form will depend on the model and the level of mobility vehicles that become a nodes on the network VANET. Thus the geographical topology of road that is used will directly affect the network performance. In this study, using toll roads. Research VANET can be done through mobility simulation. To carry out the simulation, used Opportunistic Network Environtment simulator or ONE simulator. The Simulator is used to simulate the real circumstances of a highway, where we can arrange nodes, so that it moves as vehicles such as cars and on the simulation is running with 2 speed respectively i.e. 70 km/h and 130 km/h..

A. Design System Scenario

On the process design system, needed a scenario that structured well. For making planning process easier, flowchart is needed to understand what is the process should be done in planning.

Figure 1. show that it is a flowchart of the design and implementation will be carried out on completion of the research.

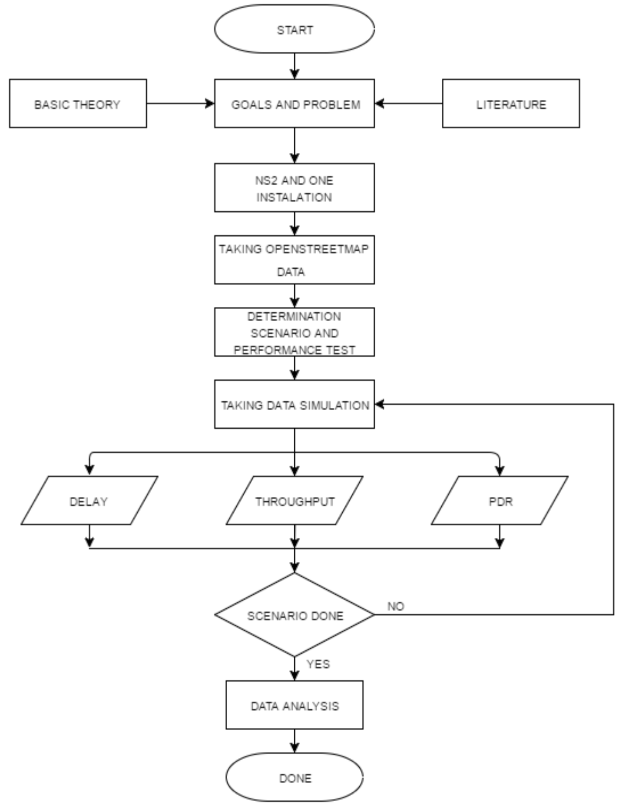


Figure 1. Flowchart design system

B. Simulation Process

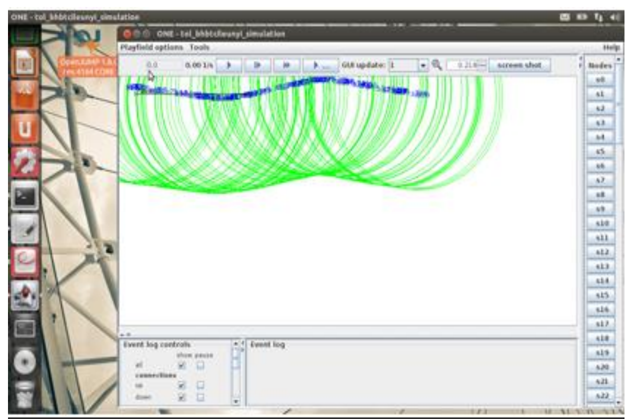
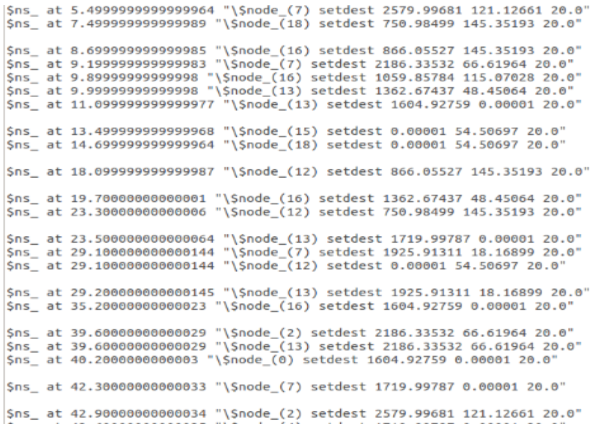


Figure 2. Mobility node

As can be seen in the image above, the nodes will be simulated with two speed, which is 70 km/h and 130 km/h. This is because like to observe at two speed with high mobility. At the time the simulation is run, each node will move following the line on the map that we have to decide in advance in a file with the extension Well Known formats (. WKT). Nodes will move in accordance with predetermined speed. When a node coincides with other nodes, they will seek to make connections with each other.



```
$ns_ at 5.4999999999999964 "\$node_(7) setdest 2579.99681 121.12661 20.0"
$ns_ at 7.499999999999989 "\$node_(18) setdest 750.98499 145.35193 20.0"

$ns_ at 8.699999999999985 "\$node_(16) setdest 866.05527 145.35193 20.0"
$ns_ at 9.199999999999983 "\$node_(7) setdest 2186.33532 66.61964 20.0"
$ns_ at 9.89999999999998 "\$node_(16) setdest 1059.85784 115.07028 20.0"
$ns_ at 9.99999999999998 "\$node_(13) setdest 1362.67437 48.45064 20.0"
$ns_ at 11.099999999999977 "\$node_(13) setdest 1604.92759 0.00001 20.0"

$ns_ at 13.499999999999968 "\$node_(15) setdest 0.00001 54.50697 20.0"
$ns_ at 14.699999999999964 "\$node_(18) setdest 0.00001 54.50697 20.0"

$ns_ at 18.099999999999987 "\$node_(12) setdest 866.05527 145.35193 20.0"

$ns_ at 19.70000000000001 "\$node_(16) setdest 1362.67437 48.45064 20.0"
$ns_ at 23.30000000000006 "\$node_(12) setdest 750.98499 145.35193 20.0"

$ns_ at 23.500000000000064 "\$node_(13) setdest 1719.99787 0.00001 20.0"
$ns_ at 29.100000000000144 "\$node_(7) setdest 1925.91311 18.16899 20.0"
$ns_ at 29.100000000000144 "\$node_(12) setdest 0.00001 54.50697 20.0"

$ns_ at 29.200000000000145 "\$node_(13) setdest 1925.91311 18.16899 20.0"
$ns_ at 35.20000000000023 "\$node_(16) setdest 1604.92759 0.00001 20.0"

$ns_ at 39.60000000000029 "\$node_(2) setdest 2186.33532 66.61964 20.0"
$ns_ at 39.60000000000029 "\$node_(13) setdest 2186.33532 66.61964 20.0"
$ns_ at 40.2000000000003 "\$node_(0) setdest 1604.92759 0.00001 20.0"

$ns_ at 42.30000000000033 "\$node_(7) setdest 1719.99787 0.00001 20.0"

$ns_ at 42.90000000000034 "\$node_(2) setdest 2579.99681 121.12661 20.0"
```

Figure 3. NS2 movement report

Based on the experiments that have been done, ONE simulator can be used as a mobility simulator (because it can produce simulations where each node moves dynamically and connections occur only when each node is at the reach of broadcast other nodes) which resembles reality node connections that move. ONE simulator is better suited to manage mobility. With the Mobility on ONE simulator after run with other simulators such as NS2.

C. *Simulation Parameter*

In Table I. show the simulation parameters to do this research.

TABLE I. SIMULATION PARAMETER

Operating system	Ubuntu 12:04 32 bits in VirtualBox on Windows 8.1 64 bit
Network Simulator	NS-2 (Version 2.35)
Mobility Model Simulator	ONE Simulator (Version 1.5.1)
Routing Protocol	DSDV
Mobility Model	Freeway based on Map
Traffic direction	2 ways
Vehicle Density	20, 40, 60, 80, 100
MAC	MAC 802_11 Ext (IEEE 802.11p)
PHY	Wireless 802_11 Ext (IEEE 802.11p)
Wave Propagation Model	Two Ray Ground
Antenna Type	Omnidirectional
Packet queuing model	Droptail
Data Traffic Source	UDP, CBR
Packet Size	512 Byte
Transmission Range	250, 500, 750 and 1000 meter
Speed of Vehicle	70 and 130 km/h
Simulation duration	300 seconds

IV. SIMULATION ANALYSIS

In the introductory section of this study have been described that scenario simulates DSDV VANET routing protocol to see the effect of changes in the transmission range on certain speed and as well as the effect of changes in the density of nodes on certain transmission range and speed. To achieve the goal of the research is to test the performance of a network, use multiple network performance parameters such as average throughput, average delay and packet delivery ratio. In further explanation of routing protocol used to refer to each parameter.

A. *Average Delay Measurement*

Delay is the time span between a packet sent with the packet reaches the destination. This delay also including propagation delay, delay queue processing time, and also the route discovery [2]. This delay parameter becomes very important because many applications VANET later that would require minimal delay may be primarily on safety related applications. Delay can be written as follows (1):

$$Delay = \frac{Time\ received\ packet - time\ sent\ packet}{\sum Received\ packet} \quad (1)$$

In figure 1 show the effect of the transmission range against delay. Can be seen on figure that the scenario for the density and velocity of node is fixed and changed the transmission range is found that delay has a tendency to decrease when the transmission range is enlarged for the same density case this is likely caused by components of the processing delay is reduced over a reduced number of hops required to reach the destination due probability route destination node is already listed in the routing table DSDV of each node and reduce update routes within the network.

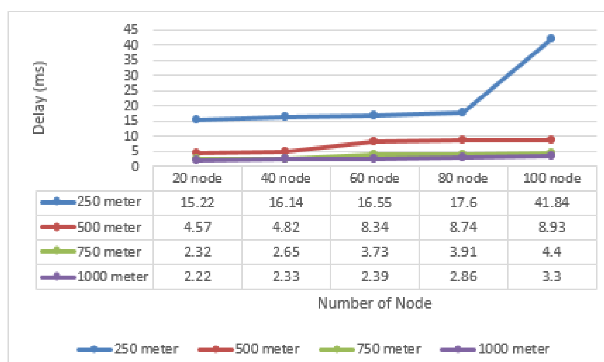


Figure 1. Delay at 70 km/h speed

As for the scenario the transmission range and speed is fixed and density of the node is being changed, increasing the density of nodes have a tendency to raise the value of delay that is likely caused by increasing value components of the queuing delay.

DSDV is proactive routing protocol where every time the network topology changes, DSDV need more to do update the route before the packet can be sent with the transmission range of low and high density nodes.

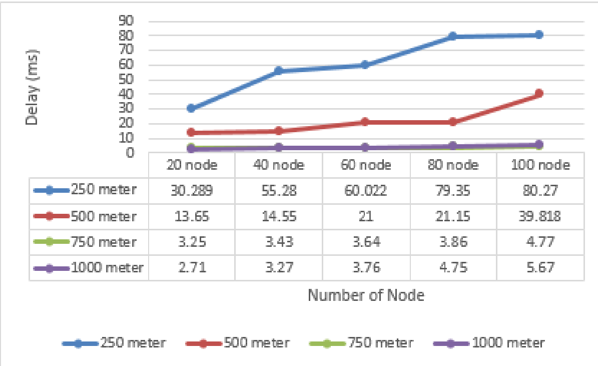


Figure 2. Delay at 130 km/h speed

While it can be seen in the figure 2 for density and velocity of the nodes is fixed and the transmission range is changed that can be found a trend going on is the value of the delay is likely to continue to decline if increasing value of the transmission range up to 1000 meters. The value of the delay decreases due to the components of the processing delay is reduced over a reduced number of hops required to reach the destination due probability route destination node is already registered at DSDV routing table of each node and minimizing update routes within the network.

As for the scenario the transmission range and speed and density fixed node and node density that changed the trend obtained equal to the same scenario earlier on lower speed i.e. delay tend to be worsen when the node density increased. Can occur due to many nodes in the network to send packets as well as for the process of routing. And when comparing the value of delay on the node speed 70 km/h with nodes 130 km/h speed found that delay had a trend for getting worse at higher speed node. This is likely due to harder process routing advertisement and routing process maintenance on a node with high speed. So routing will be updated on each node to determine a new route. For the determination of the route of the new updates require a longer time.

B. *Average Throughput Measurement*

Throughput is the average data rate that successfully received by the recipient [6]. Defined as the amount of data that has been delivered per unit of time from one node to another node [2]. These parameters describe how big the actual rate of data that can be sent over a network. Throughput is measured in units of data size per time. The units used are bits per second. Mathematically throughput can be written as equation (2).

$$Throughput = \frac{\sum Size\ of\ received\ packet}{Measurement\ duration} \quad (2)$$

In the simulation using NS2, the value is obtained by calculating the number of bit packets that have event "r" to the level "agt" which is then divided by the time span between the first and packages sent last received packet. Event r in the trace file NS2 shows that package in a condition acceptable to the receiving node. While AGT indicates that the agent trace level package is that in this case his agent in which there is UDP traffic from CBR
applications.

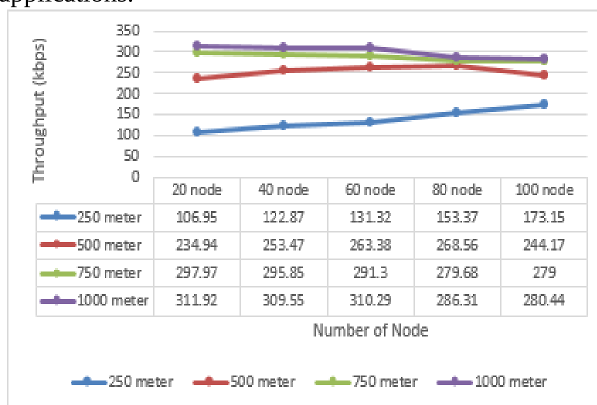


Figure 3. Throughput at 70 km/h speed

Throughput describes the condition of the data rate in a network. There are some things that affect the throughput values, one of which is the durability of the links are formed and the process of the search line until the line was formed. Then the selection of the best route will determine the performance of a routing protocol. The value throughput also affects the ratio of PDR. Can be seen in Figure 3 for density and velocity of the scenario node is fixed and changed the transmission range is found that throughput have a tendency to increase with the transmission range is increased too. This is due to the increase of the coverage of the coverage zone routing protocol proactive DSDV, chances are small for the communications network termination. The expansion of this coverage resulted in the increasing possibility of a destination node found in DSDV routing table so that the possibility of a dropped packet is decreased on the end the performance will increase the throughput.

Transmission range 250 meter and 500 meter, the throughput will be increased any presence of the increment of the density node. Because the neighbor node that resides on the source node is the transmission range to be closer. So that it can update it’s routing to the destination node properly. But on larger transmission range tends to decrease, increasing the density of the resulting decrease in value of throughput, it is caused by the growing number of neighbor nodes detected lead to increased chances of occurrence of control traffic so that the chance of occurrence of packet drop increases.

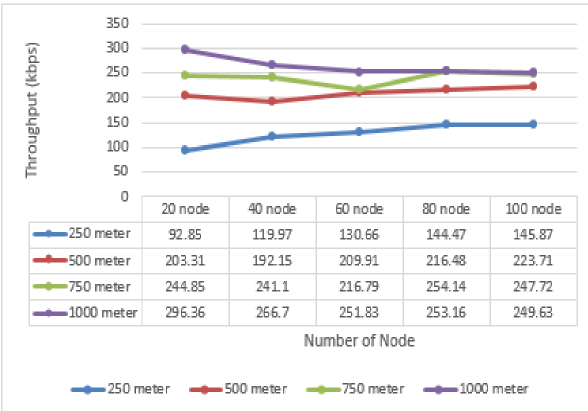


Figure 4. Throughput at 130 km/h speed

Figure 4 can be concluded that for density and velocity of the scenario node is fixed and changed the transmission range is still found the same trend tendency with the same scenario on a lower speed i.e. the throughput is going up along with the transmission range however when comparing throughput values on nodes speed 70 km/h with the scenario node speed 130 km/h throughput values was found to be worsen on the network with a higher node velocities, this is likely due to harder process routing advertisement and routing process maintenance on a node with high speed. As for the scenario the transmission range and speed is fixed and the density of nodes is changed still the same trend is occurred with the same scenario earlier at lower speeds i.e. increasing density resulting in a decline in the value of the throughput and the throughput value still tend to increase with density on the transmission range 250 m and 500 m DSDV is a proactive routing protocol. Each node in DSDV routing table for all have a destination node that is reachable on the network. This is done by performing transmission routing updates are also done when the topology changes.

C. Measurement Packet Delivery Ratio

Packet delivery ratio is a value that describes the comparison between the number of packet sent with the packet received in destination. The value of the packet delivery ratio will be similar to the value of throughput due to the equally illustrates the success of the delivery packet. Mathematically packet delivery ratio is expressed as (3):

$$Packet\ Delivery\ Ratio = \frac{\sum received\ packet}{\sum sent\ packet} \quad (3)$$

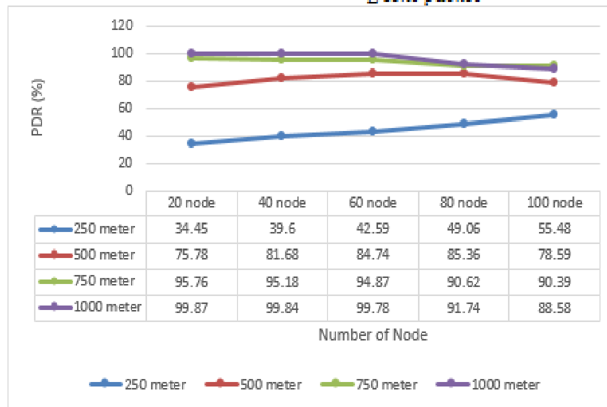


Figure 5. PDR at 70 km/h speed

From figure 5 shows if density and speed of the node is fixed and the transmission range is changed found that the value of PDR continues to increase with increasing certain transmission range. This is due to the increase of the coverage of the coverage zone routing protocol proactive DSDV. The expansion of this coverage resulted in the increasing possibility of a destination node found in DSDV routing table so that the possibility of a dropped packet is decreased on the end the performance will increase the PDR.

As for the scenario the transmission range and speed is fixed and the density of nodes is changed, the value of PDR will be obtained is increasingly coming down along with the increasing density of nodes possible causes for the occurrence of this trend is the increasing complexity of the routing advertisement procedure and the accession number of the routing updates on a network that uses a routing protocol DSDV. Different things but can be observed in scenarios that use the transmission range 250 m and 500 m, in this scenario the value of PDR is increased along with the increasing density of nodes on the network, explanation that can account for this incident was at least the neighboring nodes are detected with the transmission range 250 m and 500 m of control traffic is not too influential in this scenario but the number of hops required to reach the destination is decreased as the number of nodes increased due to the distance of the source node getting close to intermediate nodes.

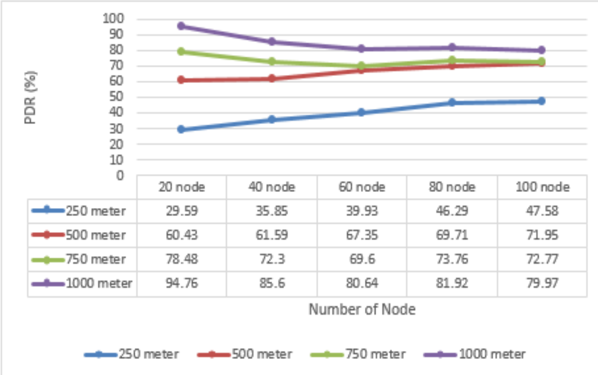


Figure 6. PDR at 130 km/h speed

Can be seen on the figure 6 scenario for using certain density and velocity of the nodes but changing the transmission range still found the trend value of PDR is equal to the same scenario at a lower speed. But when we compare the value of PDR network with nodes speed 70 km/h with a network with nodes 130 km/h speed obtained the value of PDR got worse on the network with a higher node speed it is likely due to the increasingly difficult process routing advertisement and routing process maintenance on the network with high speed node. As for the scenario the transmission range and speed is fixed and the density of nodes that change still the same trend is also available with the same scenario earlier at lower speeds i.e. increasing density resulting in a decline in the value of PDR, PDR value still tend to increase with density on the transmission range 250 meter and 500 meter.

V. CONCLUSION

Transmission range effect on network performance that using VANET DSDV routing protocol. At low density the larger transmission range which is used then the QoS parameter values will tend to increase. Because by increasing the transmission range in DSDV routing protocol will reduce the number of hops required by a node to reach the destination so that the value of the delay can be reduced which resulted in increasing the value of PDR and throughput. But as the density increases the transmission range is large, QoS parameters can also lower due to the increased traffic load control caused a rise in the number of neighbor nodes detected by proactive nature of DSDV. The denser node in the network then QoS parameter values will tend to deteriorate. QoS parameters tend to decrease. When speed of node is increased, the performance of the network will be decreased.

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