COMPARATIVE ANALYSIS OF END-TO-END JITTER DISTRIBUTION USING AODV AND DSR PROTOCOL FOR VANET ECOSYSTEM

Asyran Zarizi bin Abdullah[1]
Mohd Fazzly Rassis bin Md Kasim[2]
Safiani binti Osman[3]

Abstract

This article analyse the performance of VANET protocols in jitter distribution. Vehicle network capable of rapidly growing due to acceptance of this technology from big automotive industry such as BMW, Volvo, General Motor, Toyota and so on. Its use to improvise their automotive manufacturing and focusing on traffic safety in order to minimize the road accidents. Due to the high rate of mobility in VANET, it cause the high latency issues in variable speed and number of nodes. The AODV and DSR protocol will be simulate to investigate the best handling protocol to fix the challenge of latency. The comparison with this two reactive topology-based protocol by using average jitter as a metric. NS-2 simulation tools and OriginPro 8 will be used to generated the graphs from the trace files. The simulation results show that the AODV will perform batter, where it recorded 19.55% average of the jitter which is lower than DSR, where it recorded 91.87% average jitter for end to end nodes performance.

Keywords: VANET, Jitter, AODV, DSR

Abstrak

Artikel ini bertujuan menganalisis prestasi protokol VANET dalam Jitter Distribution. Keupayaan VANET untuk terus berkembang adalah disebabkan penerimaan teknologi tersebut daripada industry automotif utama seperti BMW, Volva, General Motor, Toyota dan sebagainya. Penggunaannya adalah untuk menambah baik proses pengeluaran automotif dan memfokuskan kepada keselamatan lalu lintas dalam usaha meminimumkan kemalangan jalan raya. Oleh kerana kadar mobiliti yang tinggi dalam teknologi VANET, ia menyebabkan masalah latensi yang tinggi dalam perubahan kelajuan bilangan nod. Protokol AODV dan DSR akan disimulasikan bagi mencari protokol pengendalian yang terbaik dalam menyelesaikan cabaran berkenaan latensi. Perbandingan dua protokol berasaskan tipologi reaktif ini dilaksanakan dengan menggunakan purata jitter sebagai metrik. Alat simulasi NS-2 dan OriginPro 8 juga telah digunakan untuk menghasilkan graf dari fail jejak. Keputusan simulasi menunjukkan bahawa AODV menunjukkan prestasi yang lebih baik, di mana ia mencatatkan purata 19.55% jitter yang lebih rendah daripada DSR, di mana ia mencatatkan 91.87% purata jitter untuk prestasi nod akhir hujung ke hujung.

Kata Kunci: VANET, Jitter, AODV, DSR

INTRODUCTION

Vehicular Ad-Hoc Network (VANET) is a technology that use to allow a connection between vehicle (V2V) and a connection to infrastructure (V2I) through the wireless network (Nagaraj and Dhamal 2012) . It is a type of ad-hoc networks where it use of short range ratio communication with another possible node, and the network is not fixed where it can be increase or decrease based on a connected node in the network. The connection in VANET uses a wire-

[1] Penulis merupakan Pensyarah Jabatan Teknologi Maklumat dan Komunikasi, Politeknik Muadzam Shah
[2] Penulis merupakan Pensyarah Fakulti Teknologi Maklumat dan komunikasi, Kolej Universiti Islam Pahang Sultan Ahmad Shah (KUIPSAS)
[3] Penulis merupakan Pensyarah Jabatan Teknologi Maklumat dan Komunikasi, Politeknik Muadzam Shah

less communication that calls dedicated short range connection (DSRC) to enable the transportation safety and fast emergency response between vehicle and roadside access point (Kumar, Mishra, and Chand 2013), for example an alert message will be sent by the accident vehicle to another vehicle in a same range in order to helping another driver to take another path to prevent a traffic congestion. VANET used IEEE 802.11p mention as Wireless Access for Vehicular Environment (WAVE), which is an enhancement protocol from IEEE 802.11 for high speed data exchange in outdoor communication (Karagiannis et al. 2011; Kumar, Mishra, and Chand 2013).

VANET is a subclass of Mobile Ad Hoc Networks (MANET) (Network and Protocolsvanet 2015), they both use wireless transmission and the node in this network will dynamically change, the difference is about the motion of the node in MANET are more structured because it operates in the low speed of movement, but the average speed of the vehicle is higher and it makes the VANET node unpredictable.

Besides that, the VANET has no issues of power consumption because it used vehicle battery power to operate, unlike MANET, that rely on a small capacity of battery in the devices (Lakshmi and Sultana 2016). VANET used routing protocol to send a packet from one node to another node. The routing protocol in VANET require a low latency to operate properly, the spreading signal of wireless ad-hoc network cannot use directly due to high rate of mobility in VANET will cause a high delay and it became challenging for vehicle network implementation (Jyoti 2015).

In this paper, we will evaluate a performance of end to end jitter of VANET using AODV and DSR routing protocol at different level of speed, in order to measure a delay of each speed and variable number of nodes. The remainder of this paper is structured as follows, the explanation of work will be in section two, then method that use will discuss in section three. The theoretically of the VANET routing protocol will be explained in section four, the selected protocol explanation of DSV and AODV in section five, the performance evaluation and simulation result in section six, and lastly is a conclusion of the paper.

RELATED WORKS

VANET has a several features that distinguish it with MANET, which is high scalability, frequently disconnected and highly dynamic network (Abdala, Aswed, and Abdala 2014). Table 1 describes a detail of VANET features.

Table 1 VANET features and description

Features	**Description**
Scalable network	Support current network workload and allow a growth of the network in the future.
Frequently Disconnected	Since the VANET network highly dynamic change because fast movement of nodes, so nodes that out of network ranges will make a frequently disconnected of the network.
Highly Dynamic Network	This ad-hoc network will dynamic change based on the movement of a node.

There is a large scale of traffic network in VANET, including the broadcast message from nodes and a message from roadside access point. The huge challenging in vehicular network implementation is about network link reliability (disconnected network) because of a highly dynamic changing of VANET (Tian, Hou, and Zhou 2016). It will increase the delay in the data transmission process for end to end nodes. To overcome the delay issue in VANET, ad-hoc routing protocol will be used. A routing protocol is responsible to determine a best path of the network, for example, if the connection between node A to F has a problem, the routing protocol will recalculate to the other path in order to make a packet receive to the destination (F). There is a lot of routing protocol in mobility network, which is OLSR, AODV, DSR, DV-CAST (Singh and Agrawal 2014), and so on, but based on our focus to reduce the end to end jitter in VANET, we will compare two protocols, which is AODV and DSR. An implementation using the NS-2 simulation tools, with the measurement based on a several speed and number of nodes, then from the result the performance will be measured and analyse.

VANET Routing Protocol show in Figure 1, consist of five categories which is Topology based, Position based, Cluster based, Geo cast based, and Broadcast based (Mutalik et al. 2017; Network and Protocolsvanet 2015). The communication in VANET using unicast, multicast and broadcast. The details of each protocol described in Table 2.

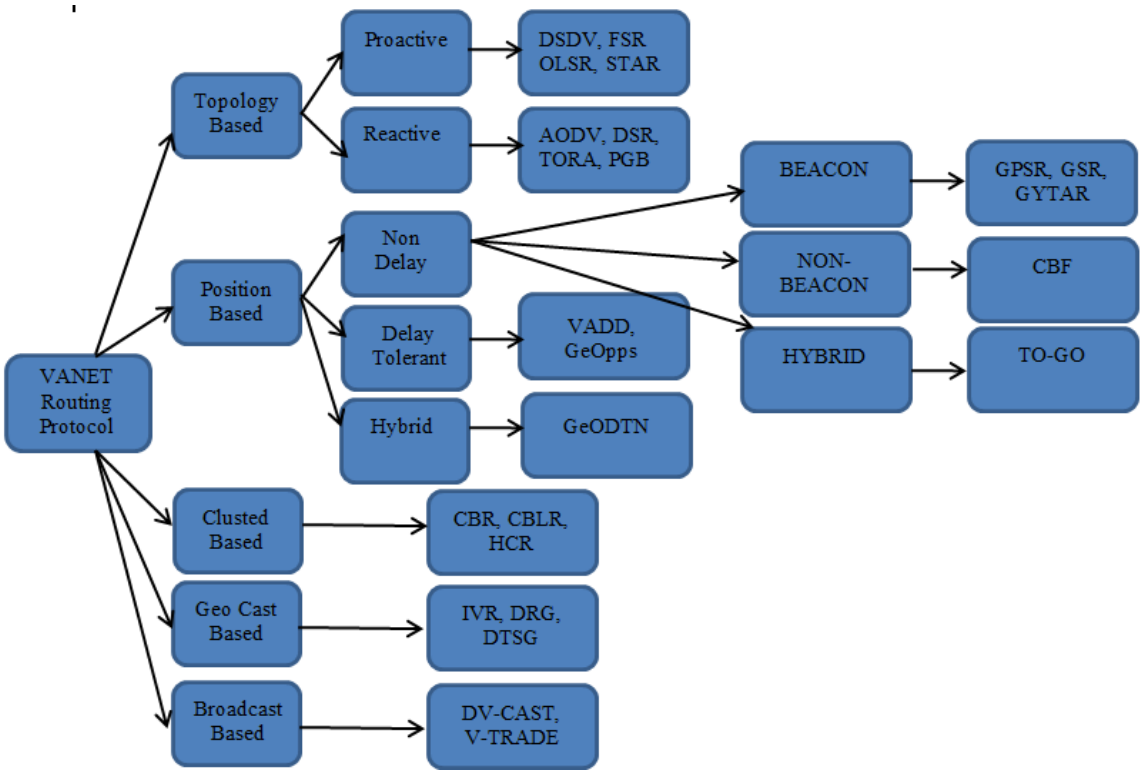

Figure 1 VANET Routing Protocol

Table 2 VANET Routing Protocol

Protocol	**Description**
Topology Based (Nagaraj and Dhamal 2012; Nasir et al. 2013)	This protocol has been inherited from MANET. Its use a exist topology information to construct a routing path.
Position Based (Femmam 2017; Network and Protocolsvanet 2015)(Patel and Jhaveri 2015)	Its depends on geographic node positional obtain with specific devices such as GPS for making routing decision.
Cluster Based (Network and Protocolsvanet 2015; Singh and Agrawal 2014)	The velocity and direction are group together in cluster. Used cluster head if the direction node outside the network.
Geo Cast Based (Femmam 2017; Nagaraj and Dhamal 2011; Toulni and Nsiri 2015)(Hasrouny et al. 2017)(Toulni and Nsiri 2015)	Used a multicast routing to deliver a message to all vehicles situated in a geographical area. Use GPS to determine each neighbour.
Broadcast Based (Femmam 2017)	It uses to enhance the probability reception of a message to a destination with high bandwidth cost. Suitable for scattered networks, but become less efficient when density increases.

OVERVIEW OF PROTOCOL

The selected vehicle protocol used in this paper is AODV and DSR, both are from reactive topology based, it has been the choice because reactive topology route only discover when it needed, and this process will help to reduce a flood on a network traffic (Chitra, Sivasathya, and Muthamizh 2014), in order to catch a low delay data transfer.

a) Dynamic Source Routing (DSR)

The Dynamic Source Routing is an on-demand routing protocol in reactive topology based protocol. It build for wireless multi-hop ad hoc mobile network and applies two type of routing mechanisms, which is a route discovery and route maintenance. The function of both routes as show in Table 3.

Table 3 DSR route mechanism

Type of routing	**Description**
Route Discovery	Used when the source node (A) wants to send a data to the destination (X), but do not know the path to (X). So DSR will broadcast the packet to find where is (X) (Network and Protocolsvanet 2015)
Route Maintenance	Used when the source node gets the error message about the broken path between the source node (A) to the destination node (X). The DSR will invoke router discovery to find a alternative path to the destination (X) (Khairnar and Kotecha 2013)

DSR can manage and configure by its own without need an administrator (Nagaraj and Dhamal 2012) . The connection in DSR need to establish before sending the packet, the network need to maintain the cache node that contain a path from soure to destination, and it store on each node temporary storage (Khairnar and Kotecha 2013). If not, DSR need to run a route discovery to find a path to destination. Figure 2 show a process how DSR works.

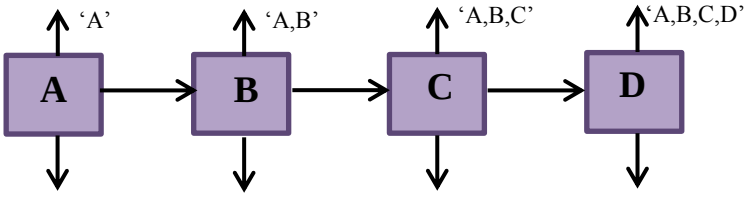

Figure 2 DSR route mechanisms

1. Source node A need to connect to a destination node D, then it will send a request to the neighbour node.

2. Then, the node B will receive the request, but if the node B path has been stored in path record before, so it will discard the new request.

3. Node B will forward the request message to next hop node, same goes to node C, until destination node D receives the request.

4. When node D receives the request message from source node A then it will reply back to route reply contain a path between a source node A to destination node D.

But if the request message is failed during transmission, so the node will send a Router Error to the source node, then the source will refer to the last resort of receiver node and forward request message again.

b) Ad Hoc On-Demand Distance Vector (AODV)

AODV is a routing protocol developed between node sender and node receiver, and it can be used in unicast or multicast. It that has a similarity function with DSR protocol. AODV uses a several message such as Router Request (RREQ) Broadcast, Router Reply (RREP) Propagation and Router Error (RERR) Message (Tyagi, Som, and Rana 2016). When a node wants to transfer a packet to another destination node, it will verify the path in the routing table, to ensure if the destination path have already stored in the routing table or not. If the path is there, the packet will be use same path to send a packet, but if not, the source will broadcast a RREQ (Kuppusamy, Thirunavukkarasu, and Kalaavathi 2011). RREQ as show in Figure 3 is a process to find a destination for the node. A sender node will send the packet request to all nodes in the network, and then if node is not a destination, it will broadcast to another node

until it finds the receiver node. The sender node will use a ring search technique to minimize wide network broad casting of RREQ (Gavande and Mhala 2012).

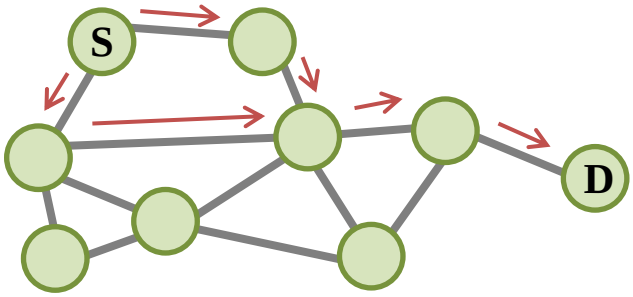

Figure 3 RREQ

When the node receives a message from sender node, then the receiver node will reply back to the source node with generating the RREP Propagation show in Figure 4 to inform that the destination node already receives the message. This message will deliver in the unicast transmission (Zangeneh, Navaezadeh, and Jafari 2014).

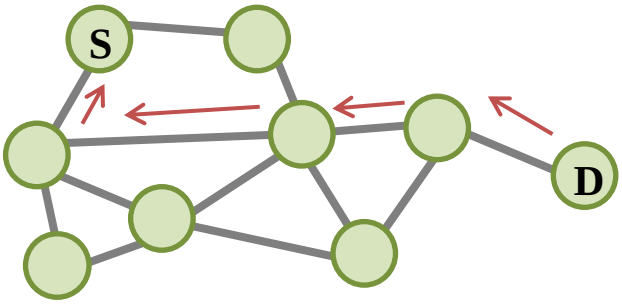

Figure 4 RREP

When sender node receive a RREP message, then the connection has established and sender node can start to send a packet. Then, if the connection between sender and receiver node has a lost connection, the node connected to the connection will send RERR Message show in Figure 5 to inform to all node about the problem, and sender node needs to broadcast RREQ again to find a new path (Zangeneh, Navaezadeh, and Jafari 2014).

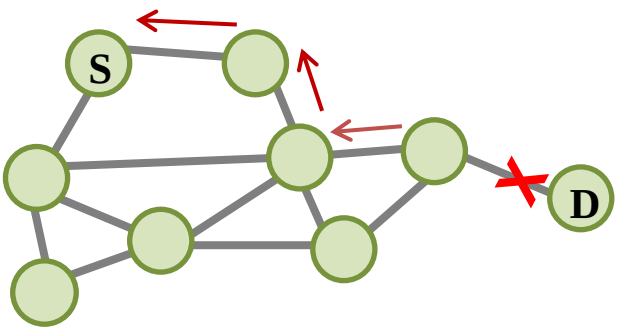

Figure 5 RERR

The VANET routing protocol DSR and AODV have some differences in in a way of forward a packet to the node destination, where AODV send a packet that only contains a destination address, but DSV contains a full routing information from source to a destination, its easy to network troubleshooting (finding the failure node) compare to AODV, but this process make an overhead routing in DSV (Ibrahim and Bikas 2011).

METHODOLOGY

The project overview as shown in Figure X describe about project flow and the implementation from first step to the end. The both protocol which is AODV and DSR will be evaluate in term to get the jitter which the lower jitter will become the best approach for VANET implementation. The protocol of AODV and DSR will be setup in NS-234 Linux simulation and it will be evaluate based on the measurement of number of nodes and nodes speed. The result for both test will be analyse to determine the best handling protocol to fix the challenge of latency.

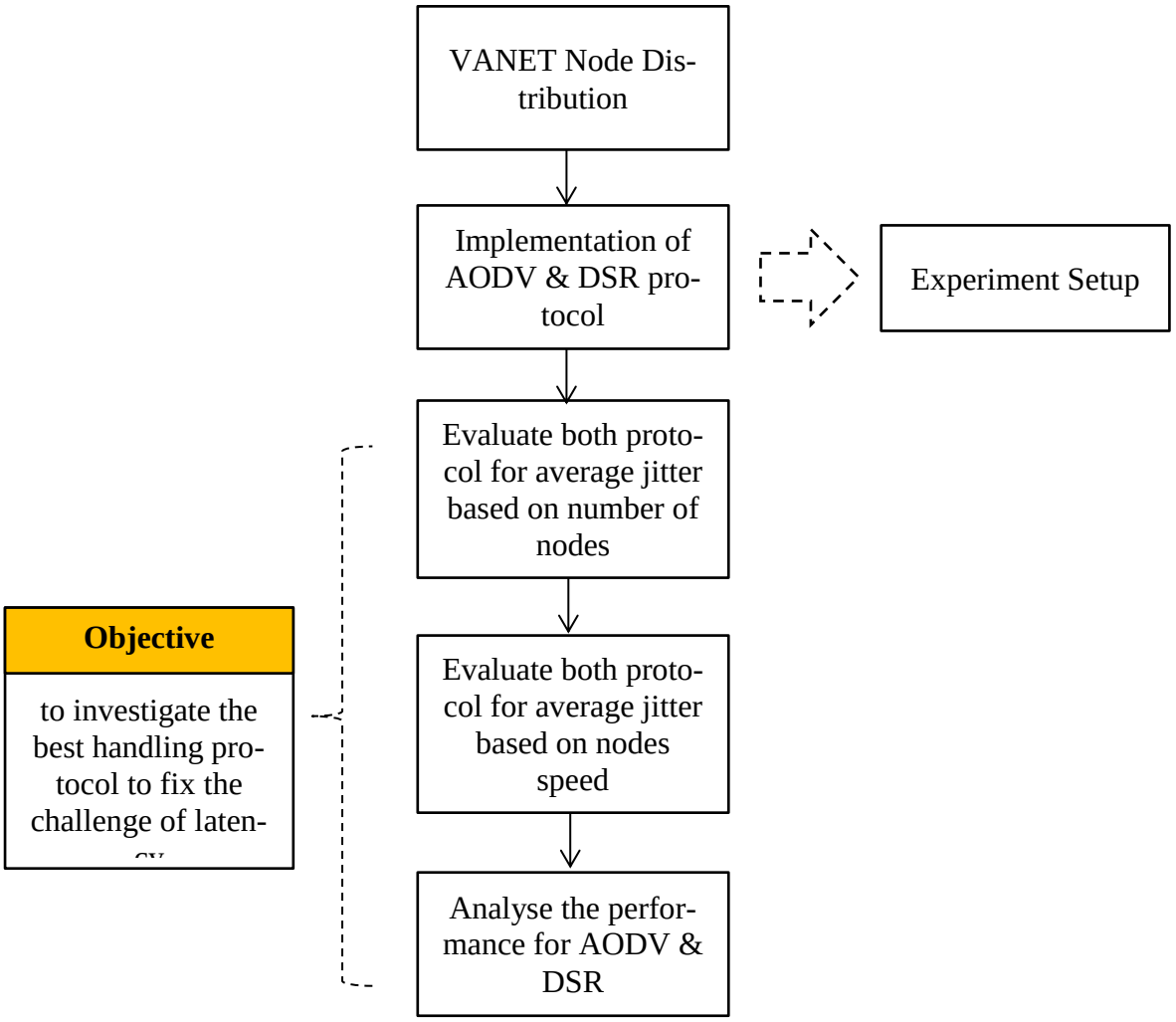

Figure X Project Framework

EXPERIMENTAL SETUP

The NS-234 simulation is used to measure a performance of AODV and DSR protocol. The simulation area size is 800 X 950 meter with multiple number of nodes (5, 10, 15, 20 and 25) and speed (5, 10, 15, and 20 kmh) as a parameter to calculate the end-to-end jitter. Its use 9000 second maximum time to operate the simulation, then the graph will generate to compare the performance and find the low delay in both protocols. Table 4 shows a detail of the parameter used in this paper.

Table 4 Parameter used in this simulation process

Parameter	Value
Network Simulator	NS 2.34
Propragation Model	Propagation/TwoRayGround
MAC Type	802.11 IEEE
Antenna Model	Antenna/OmniAntenna
Simulation Area	800 x 950m
Maximum packet	50 ifq
No. of vehicales	5/10/15/20/25
Speed of vehicles	5/10/15/20 (kmh)
Routing Protocol	AODV and DSR
Simulation Time	9000 (s)

RESULT AND ANALYSIS

End-to-end jitter is the performance metric that will be used, to analyse a performance of two reactive topologies-based protocol, which is AODV and DSR. Its describe an average of variable delay that used to measure a latency of packet delivery over the vehicle. The number and speed of nodes also used as a parameter to find the average jitter in VANET. The graph in Figure 6 and result of the number of nodes as shown in Table 5.

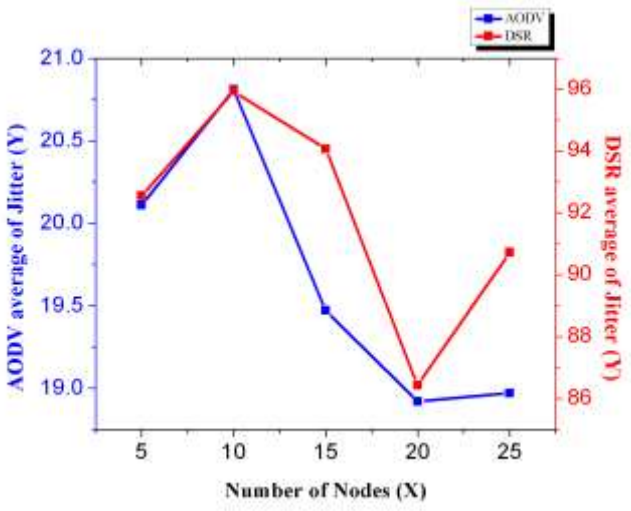

Figure 6 Average jitter vs number of nodes for AODV and DSR

Table 5 Parameter used in this simulation process

No. of Nodes	**AODV**	**DSR**
	Average of Jitter	
5	20.11	92.55
10	20.81	95.93
15	19.47	94.07
20	18.92	86.43
25	18.97	90.72

Result in Table 5 which illustrated in Figure 6, the variation of jitter in various numbers of nodes show that, average jitter is high for DSR scenario compare to AODV, it is because DSR uses more than one route to transfer data packets from source node to the destination node and AODV protocol just use single path of route to send a packet until the connection failed, then its will discover a new path to the destination and its show that AODV will give a less variation of delay.

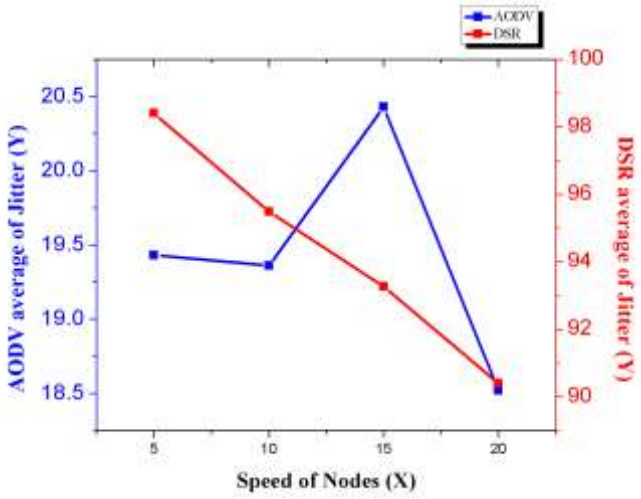

Figure 7 Average jitter vs speed of nodes

Table 6 Parameter used in this simulation process

Speed of Node (KM/H)	**AODV**	**DSR**
	Average of Jitter	
5	19.43	98.40
10	19.36	95.48
15	20.43	93.26
20	18.52	90.39

The Table 6 which illustrated in Figure 7, describe about the jitter of the speed of nodes. The figure explains that, the variation of delay in various speeds of nodes shows the jitter will decrease when the vehicle increase the level of speed, it is because if the node move slowly it will make packet transmission from one node to another causes more delay. The

AODV average jitter is low compared to DSR due to the DSR using more than one route to operate the packet transfer, but only one route used by AODV to operate the same operations.

CONCLUSION

VANET is used to provide real time communication on vehicles, in order to send a traffic information to the connected vehicle. This paper is based on the study of two protocols which is AODV and DSR, the protocol has been simulate using numbers and speed of nodes as a parameter on the jitter. The DSR has a memory to store all the path from source to destination, while AODV will only know their destination. In term to recover a path error, the DSR is a best choice, but for VANET implementation, which its need the fasters communication from one node to another, AODV more suitable. With less overhead, low jitter and delay make AODV is the best handling protocol to fix the challenge of latency. In future, this paper can be enhanced by analyse other ad-hoc routing protocol with different parameter and metric for example AODV with DV-CAST or other protocols.

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