Evaluating VANET Routing Protocols for Auckland Area

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***Abstract*—This paper provides a performance evaluation for several popular Vehicular Ad-Hoc Network (VANET) protocols, namely AODV, DSR, OLSR, DSDV, GPSR, CBRP, and ZRP with Nakagami fading propagation model for Auckland area. The impact of the shape factor of the Nakagami model on the performance is investigated for each of the studied protocols, and for three types of traffic: low, medium and high traffic. Two real scenarios are considered: urban area (central of Auckland), with a maximum speed of 50 km/h, and motorway, with a maximum speed of 100 km/h. Results show that the performance of the protocols varies and depends on several factors including the number and the speed of vehicles**

Keywords*— *VANET routing protocols, performance analysis

I. Introduction

The substantial growth in vehicular traffic in recent years necessitates new ways to handle and manage traffic. Intelligent transport systems (ITS) aims at monitoring and regulating traffic automatically in an improved and efficient manner [1][2].

Vehicular Ad-Hoc Network (VANET) is a major part of ITS. It was primarily developed to improve safety and comfort for vehicles, passengers and drivers. The environment where vehicles and the traffic system communicate influences the choice of a suitable routing protocol for VANET and helps in addressing the design challenges of these routing protocols [3][4]. Different VANET routing protocols have been evaluated and compared under different environmental conditions [5][6][7][8][9]. Here we evaluate the performance of several popular VANET protocols under Nakagami propagation model for Auckland area.

II. System Design and Evaluation

The protocols considered in this paper are: Ad-Hoc on Demand Distance Vector (AODV), Optimized Link State Routing (OLSR), Dynamic Source Routing (DSR) Destination-Sequenced Distance Vector (DSDV), Greedy Perimeter Stateless Routing (GPSR), Zone Routing Protocol (ZRP) and Cluster Based Routing Protocol (CBRP). Three values for the shape factor of Nakagami are examined to find the best configuration for each protocol, which are *m*=1, 2, 3. Nakagami model can characterize different models and achieve more realistic modelling. It can reflect certain environmental conditions and the consequences on reception power [10][11]. The performance of the protocols

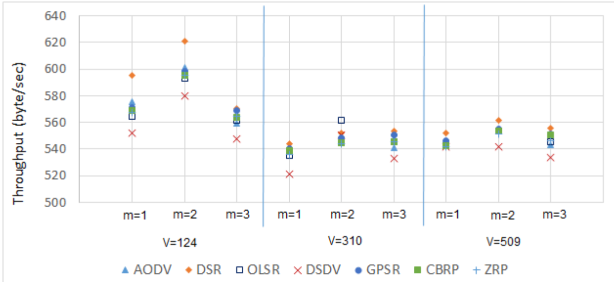

Fig. 1. Throughput (byte/sec) for Auckland CBD scenario.

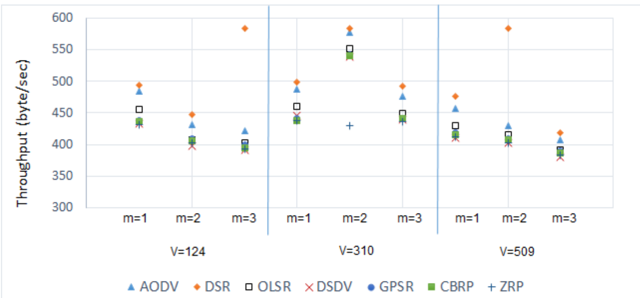

Fig. 2. Throughput (byte/sec) for Auckland motorway scenario.

is compared for two real scenarios: urban area and highway. For the urban area, we have selected Auckland central business district (CBD) with maximum speed of 50 km/h, and for Auckland motorway the maximum speed is chosen to be 100 km/h. The performance of the protocols is compared according to three metrics: Packet Error Rate, End-to-End Delay and Throughput. Three traffic types are considered: low traffic, medium traffic and high traffic. Simulations are carried out using OMNET++ and SUMO simulators, with scenarios configured to reflect real-world conditions.

Figs. 1-6 summarize our experimental results for Auckland CBD scenario and motorway scenario. V in the figures is the number of vehicles and *m* is Nakagami shape factor. Each figure presents the results in three sections; the low traffic finding (when V=124), the medium traffic finding (when V=310) and high traffic finding (when V=509). As it can be seen from the throughput figures (Figs. 1 and 2), DSR has almost the highest throughput for all types of traffic (low, mid, high). This is because in DSR the source node attaches the complete route in the packet header to reach the destination node. Therefore, the intermediate nodes do not need to update the information on the crossing path. The second best protocol regarding the throughput for all types of traffic and for all values of *m* is AODV due to its low overhead, as each node propagates only hello messages

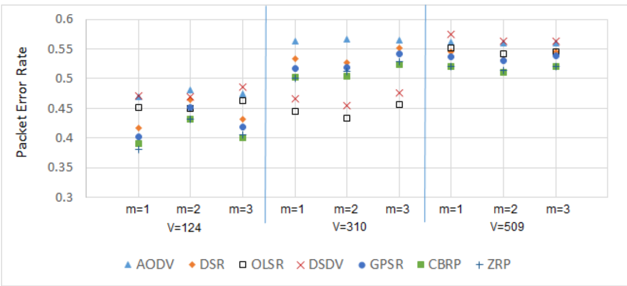

Fig. 3. Packet error rate for Auckland CBD scenario.

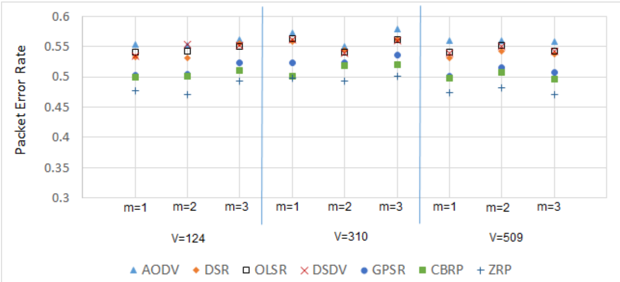

Fig. 4 . Packet error rate for Auckland motorway scenario.

to its neighbors and there is no need to broadcast any update. On the other hand, DSDV has the worst throughput.

In terms of packet error rate (PER) in Figs. 3 and 4, AODV gives the worst performance most of the time, as it faces with a long delay due to the route initialization. For Auckland CBD. CBRP and ZRP protocols gives the best PER for low and high traffic, although for high traffic the performance of all protocols are bad in general. For medium traffic, OLSR and DSDV give the lowest PER. In motorway scenario, protocols performance is more stable manner with ZRP gives the best PER followed by CBRP

For end-to-end delay, in Fig. 5 and Fig. 6, it is clear that both OLSR and DSDV achieve the lowest delay, for both scenarios. This is because OLSR provides a route to a destination immediately and DSDV maintains only the best path and guarantees loop free paths. DSDV nodes do not need to execute route discovery process before packet transmission, since they have the current routing information in their routing tables. On the other hand, ZRP gives the worst performance in terms of the delay, followed by AODV due to its route initialization mechanism.

III. CONCLUSION

From the above results, it is evident that there is not a single VANET protocol that suits all cases. Choosing the right protocol strongly depends on the application. For example, DSR protocol has high throughput, but it does not have good immunity against error, and its delay is high. ZRP on the other hand, has good packet error rate, especially for high speed, but it throughput is among the lowest and it has the highest delay. DSDV protocol has the best delay performance, but its throughput is among the lowest. Knowing the required services, whether is it real-time service, service with hight reliablity, or service that needs fast deliverly, then one of these VANET protocol will be the right choice, taking into account the type of traffic and Nakagami shape factor, which represent the enviroment.

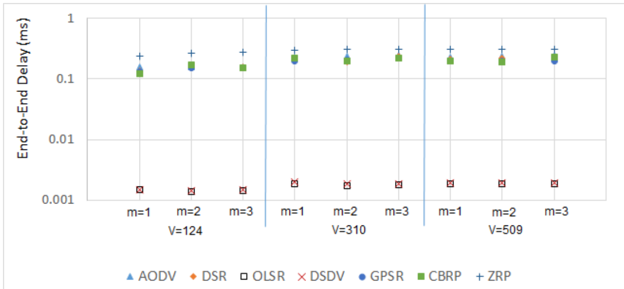

Fig. 5. Delay for Auckland CBD scenario.

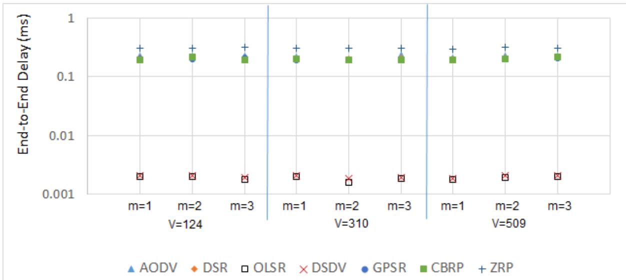

Fig. 6. Delay for Auckland motorway scenario.

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