Evaluating VANET Routing Protocols for Auckland Area

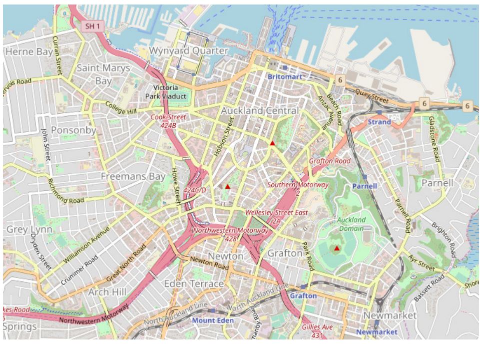
Naji Alobaidi , Bashar Barmada, Iman Ardekani, Guillermo Ramirez-Prado
Computer Science Department, Unitec Institute of Technology
Auckland, New Zealand

1- Introduction

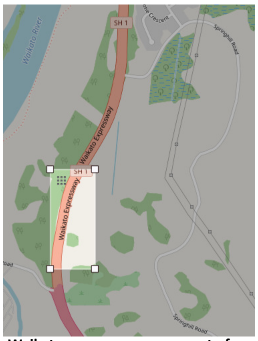
Objective

Provide 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 (Urban and motorway).

Question to Answer: Which VANET protocol suits which scenario the best, and under which conditions?



Auckland city center (CBD) map



Waikato expressway map, part of Auckland motorway

2- Study Environment

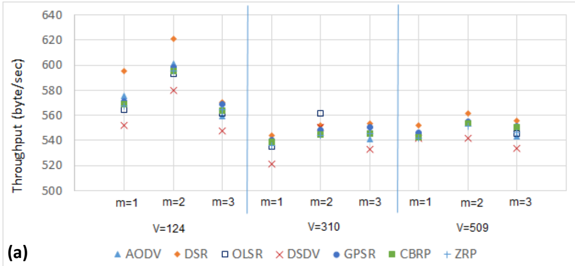
Parameter Name	Value
Simulation Environment	OMNET++ and SUMO
Number of Vehicles	124 (low traffic), 310 (medium traffic), 509 (high traffic)
Routing Protocols	AODV, DSR, OLSR, DSDV, GPSR, CBRP, ZRP
Speed	Central Auckland: max speed 50 km/h Motorway: max speed: 100 km/h
Nakagami Shape Factor	m=1, 2, 3
Mac Bit Rate	6 Mbps
MAC	802.11p Wireless access in vehicular env.
Transmit Range	250 m
Packet Size	512 Byte
Traffic Type	UDP
Simulation Area	6000 × 6000 m^2

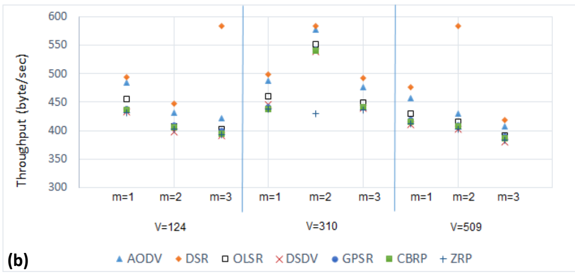
Metrics of Evaluation:

- Throughput: Data packets delivered in a time unit from one node to another in the network.
- Packet Error Rate (PER): The ratio of the incorrectly received data packets to the total number of received packets.
- End-to-End Delay (EED): The time taken for data packets to be transmitted from the source to destination

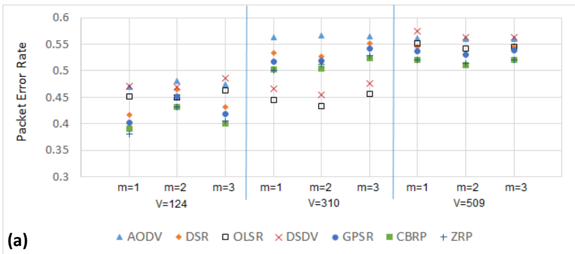
Protocols Abbreviations
AODV: Ad-Hoc on Demand Distance Vector
OLSR: Optimized Link State Routing
DSR: Dynamic Source Routing
DSDV: Destination-Sequenced Distance Vector
GPSR: Greedy Perimeter Stateless Routing
ZRP: Zone Routing Protocol
CBRP: Cluster Based Routing Protocol

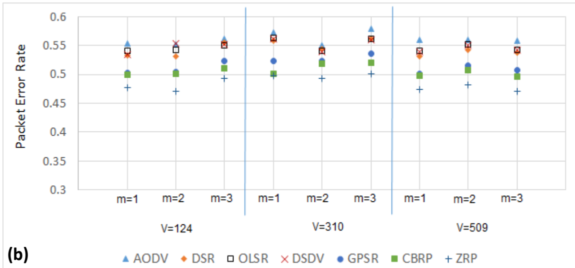
3- Results Evaluation



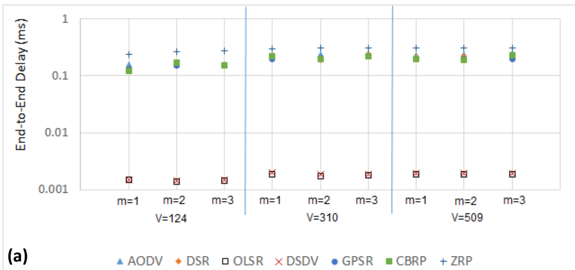


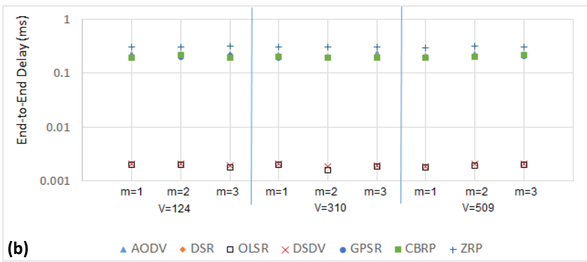
Throughput (byte/sec) for Auckland CBD (a) and Motorway (b) for VANET protocols. *m* is the Nakagami shape factor, *v* is the number of vehicles.





Packet error rate for Auckland CBD (a) and Motorway (b) for VANET protocols. *m* is the Nakagami shape factor, *v* is the number of vehicles.





Delay for Auckland CBD (a) and Motorway (b) for VANET protocols. *m* is the Nakagami shape factor, *v* is the number of vehicles.

4 – Result Evaluation

Throughput

- The best for for all traffic types: DSR, as the source node attaches the complete route in the packet header → the intermediate nodes do not need to update the information on the crossing path.
- The second best (for all traffic types for all values of *m):* AODV, as it has a low overhead - each node sends only hello messages to its neighbors (no need to broadcast any update).
- The worst: DSDV - nodes need to broadcast periodic updates and event-driven updates

Packet Error Rate

- Best (Auckland CBD): CBRP and ZRP for low and high traffic. OLSR and DSDV for medium traffic.
- Best (Motorway): ZRP followed by CBRP. In general protocols performance is more stable manner.
- The worst: AODV – as it suffers from long delay due to the route initialization (packets are queued and dropped before transmission)

Delay

- The best (both scenarios): OLSR and DSDV
  - OLSR provides a route to a destination immediately.
  - DSDV maintains only the best path and guarantees loop free paths (no need for nodes to execute route discovery process before packet transmission, since they have the current routing information in their routing tables).
- The worst: ZRP followed by AODV due to its route initialization mechanism.