Evaluation of channel access techniques in vehicular ad hoc networks

Razvan Stanica, Emmanuel Chaput, André-Luc Beylot

Institut de Recherche en Informatique de Toulouse

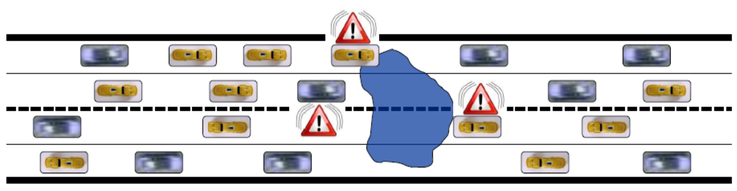
Introduction

¤ As the number of vehicles has been continuously growing in the last century, transportation safety has also become a more and more important issue for our society.

¤ A Vehicular Ad-Hoc Network (VANET) would allow vehicles to exchange information acquired using in-vehicle sensors and would assist drivers in their decisions.

¤ The Medium Access Control (MAC) protocol in VANET needs to cope with unique requirements and challenges

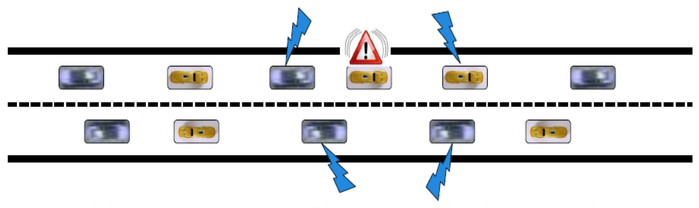
¤ Several solutions based on Carrier Sense Multiple Access (CSMA) and Time Division Multiple Access (TDMA) have been proposed in the standardization organizations.



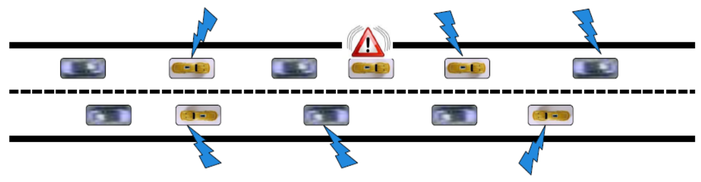
Compared Protocols

IEEE 802.11p :

¤ Based on WiFi - mature and affordable
¤ Known problems in broadcast mode
¤ Never implemented in large-scale multi-hop networks



40% > 60% : Delivery ratio in the close neighborhood is a crucial metric in VANETs



Self-organized TDMA :

¤ Industrial standard for maritime and avionic communications
¤ Distributed and loose synchronization requirements

Listen the medium for a frame

Create a local image of the next frame

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Loc 1	Loc 2		Loc 4	Loc 5	Loc 6	

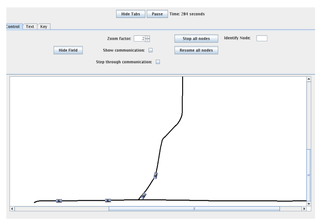
Choose a free slot

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7

Reuse the farthest slot

Pick a random validity time for the slot

Simulation scenario

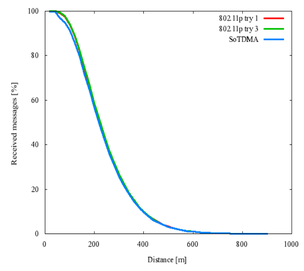


¤ Simulator: JiST/SWANS
¤ Mobility model: Street Random Waypoint on real map
¤ Radio propagation: Shadowing
¤ Vehicle density: 5 veh/km/lane - 50 veh/km/lane
¤ Beaconing frequency: 2 Hz

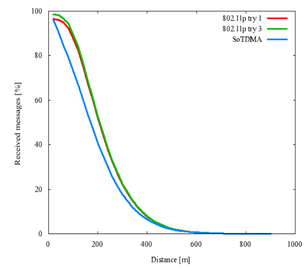
Results

Beacon reception probability as a function of the distance between the source and the receiver

Low vehicle density

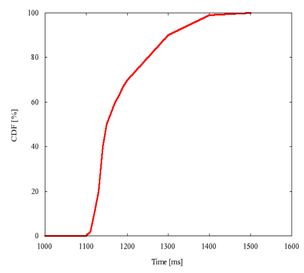


Medium vehicle density

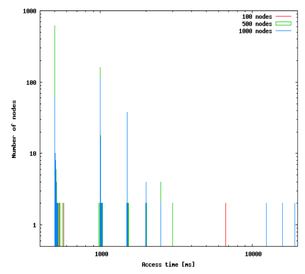


¤ Similar results in low traffic density
¤ SoTDMA performances drop when traffic density grows: discrimination zone

¤ SoTDMA ensures a maximum channel access time for all the vehicles
¤ IEEE 802.11p creates "ghost nodes", vehicles that can not access the channel for 10-20 seconds



SoTDMA
- CDF -



IEEE 802.11p
- values on log-log axis -

Maximum channel access time for all the vehicles

Conclusions

¤ A vehicular network with no stringent requirement would be feasible using any of the two protocols

¤ SoTDMA can not cope with increasing car density

¤ IEEE 802.11p can not guarantee fairness, not even in low traffic density

¤ Neither of these access methods can be used for a network dedicated to traffic safety

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