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Selective Broadcast for VANET Safety Applications

Kaan Bür, Maria Kihl

Emergency situation warning is one of the most popular potential applications for vehicular ad hoc networks (VANET). Due to their life-critical nature, however, they must meet very high quality standards, such as reliable and timely delivery of the safety warning in a situation like car collision avoidance. In order to put the candidate solutions to the test, we implement four different selective broadcast algorithms used for information dissemination in VANET, and analyse their delivery performance under identical and realistic simulation conditions. The results we obtain help us to understand better the design requirements of a high-performance selective broadcast algorithm.

Evaluation Scenario

In order to evaluate the effectiveness of selective broadcast in vehicular safety applications, we implemented 4 different algorithms based on the ideas in [1], [4], [3]. These algorithms, upon encountering an emergency situation, initiate a periodic broadcast sequence and start sending warning messages. Upon receiving a warning message, other vehicles start their own periodic broadcast sequence provided that the warning comes from a vehicle in front of them. The difference between the algorithms lies in their stopping conditions and random waiting times before transmission. As our tool for discrete event simulation, we have chosen ns-3 [2]. We ran the simulations 100 times with different random number seeds for each algorithm described above and each different value of the chosen variable.

Table I
Simulation Parameters

Description	Value
Number of vehicles *(variable)*	20, 40 .. 100
Wireless transmission range	300 m
Emergency warning message size	100 B
Emergency warning message interval	100 ms
Wait-before-send time *(minimum .. maximum)*	0 ms .. 10 ms
Vehicle speed *(minimum .. maximum)*	60 km/h .. 120 km/h
Deceleration rate	4 m/s^2
Driver reaction time	1.6 s

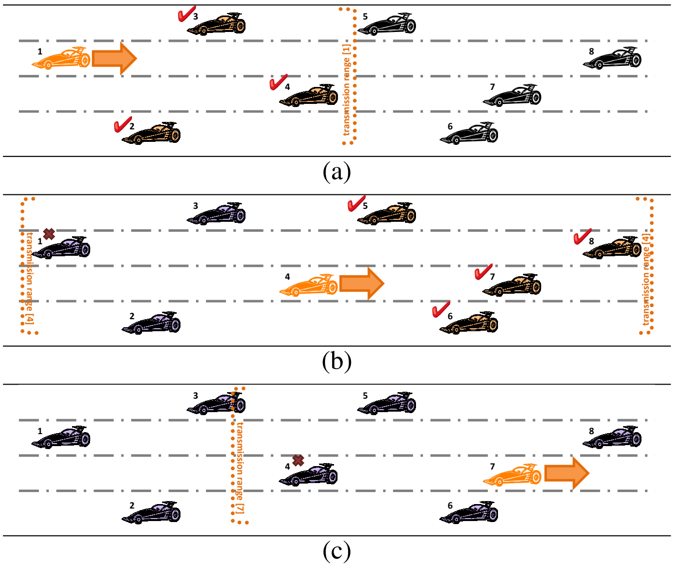

Figure 1. An example showing, in 3 snapshots from a highway with 4 lanes and 8 cars, how selective broadcast works: (a) Periodical emergency warning broadcast is initiated by car 1. The warning is received by cars 2, 3, 4. (b) Car 4 propagates the message. Car 1 overhears this and cancels its own broadcast sequence. Cars 5, 6, 7, 8 receive the warning. (c) Car 7 propagates the message. Car 4 overhears it and cancels its own sequence.

Results and Conclusion

The effectiveness metric is defined as the percentage of the vehicles having received the collision warning while their distance to the accident is still sufficient to stop in time. According to the simulation results, all 4 algorithms suffer from network disconnectivity when the density of nodes is not high enough to propagate and keep alive the warning. The successful delivery rate can be as low as 0.5 in sparse networks. As the network density increases, the success rate exceeds 0.9. The results show that much work remains to be done to realise safety applications with 100% reliability, so they can be widely and safely used in vehicles. It is necessary, for instance, to study adaptive broadcast techniques to overcome the problem of sparse networks. More accurate mobility models can be incorporated into the simulations, containing elements for changing lanes, keeping the safety distance, platooning, and driver behaviour. Our research plan for the near future is to address these issues.

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References

[1] S. Biswas, R. Tatchikou, F. Dion, "Vehicle-to-Vehicle Wireless Communication Protocols for Enhancing Highway Traffic Safety", *IEEE Communications Magazine*, Vol. 44, No. 1, pp. 74-82, January 2006.

[2] The ns-3 network simulator, available online at http://www.nsnam.org, last accessed 27 August 2010.

[3] L. Briesemeister, G. Hommel, "Role-based Multicast in Highly Mobile but Sparsely Connected Ad Hoc Networks", *Proceedings of Mobile and Ad Hoc Networking and Computing*, pp. 45-50, Boston, USA, 11 August 2000.

[4] M. Nekovee, "Epidemic Algorithms for Reliable and Efficient Information Dissemination in Vehicular Ad Hoc Networks", *IET Intelligent Transportation Systems*, Vol. 3, No. 2, pp. 104-110, June 2009.