A Selection Metric for Backup Group Creation in Inter-Vehicular Networks

Møller, Erling Matthiesen; Schwefel, Hans-Peter; Renier, Thibault Julien

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A Selection Metric for Backup Group Creation in Inter-Vehicular Networks

A step in the way of distributed ad-hoc group state-sharing

Erling Vestergaard Matthiesen, Thibault Renier and Hans-Peter Schwefel

Aalborg University, Denmark

Introduction

- Reliable service provisioning in car-to-car networks is challenging
- The environment is very dynamic
  - and network topologies are changing rapidly
  - communication is unreliable
- For service-level fault-tolerance, the service needs to be replicated onto several vehicles.
- For state-full services a careful choice of the replica servers is necessary

Approach:

- Investigate methods for group forming based on different metrics
- Compare performance of end-to-end delay metric with geography based metric
- Groups used to form clusters for service provisioning
- Groups must adapt to topological changes in car-to-car network
- Adaption requires much effort, keep number of group changes as low as possible
- Utilize that cars movement is limited by road infrastructure

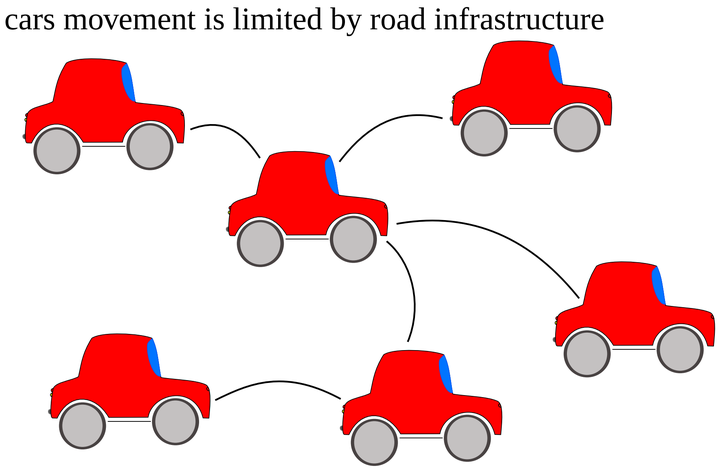

Figure 1: *The scenario is car-to-car networking in urban environment with dense traffic*

Methods

Different methods are used to evaluate the performance of the heuristic geo-cost metric.

- Simulation, simulating detailed behavior of an application
- Performance is measured with respect to inconsistency in the shared state variables
- Performance is measured with repsect to the number of times the group configurations change

Metrics

- Geo-cost metric based on geographic position of nodes, speed and direction
- Compared to end-to-end delay metric

Results

The two road sections in Figure 3 and 4 show the same topology when the delay metric has been used for grouping the nodes and when the geography based mteric is used.

- Results show that geography based metrics group cars moving in the same direction
- The number of circles on the plots in Figure 5 shows that the number of times the group configuration has changed during a simulation is lower if the geographical metric is used
- The application performs equally well as if the end-to-end delay metric is used for group division
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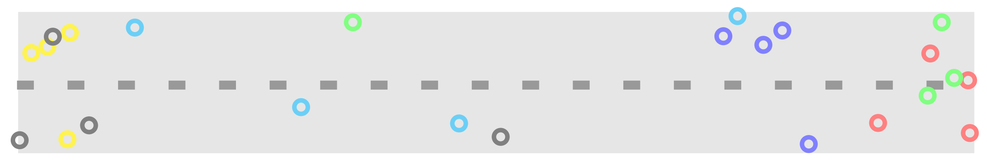

Figure 3: *Topology with groups created by using the delay metric as input for the heuristic algorithm.*

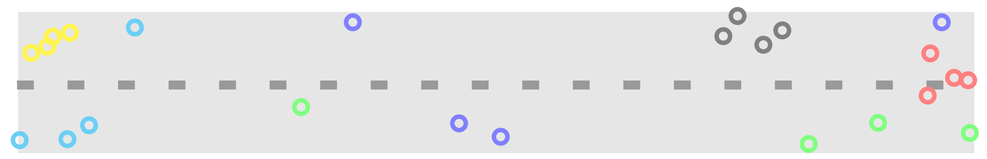

Figure 4: *The same topology with groups created by geo-cost.*

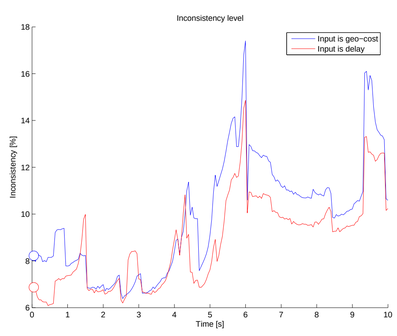

Figure 5: *Results from an experiment where the grouping algorithm was used in the beginning of the experiment to see how well the*

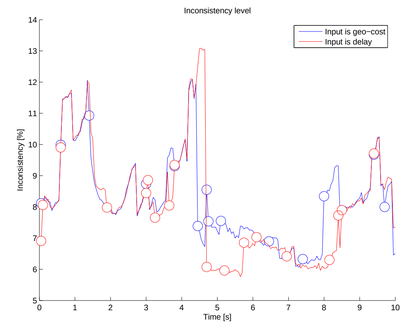

Figure 6: *Results from the same experiment as Figure 4 but this time the group creation algorithm was used at each time step. The circles indicate that a new group configuration was found.*

Conclusions

- It has been shown that the new Geo-cost metric performs as well as end-to-end delays while being easier to obtain.
- Geo-cost provides a reasonable compromise between keeping inconsistency in the groups low.
- Geo-cost takes advantage of the structured movements of cars (restricted to roads) in creating backup groups.
- The short term predictions of car positions saves reconfiguration efforts.

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