Localized Group Membership in Highly Mobile Ad Hoc Networks

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1 Introduction

In inter-vehicle communication, vehicles in road traffic are equipped with a radio modem allowing them to contact other equipped vehicles in their vicinity. By acquiring and exchanging information, vehicles build knowledge about the local traffic situation which can improve comfort and safety in driving. As an example, vehicles inside a traffic jam learn about the current size and position of the congestion. Such information can yield up-to-date navigation guidance and also prevent fast vehicles from colliding with the stopped vehicles.

The vehicles form a mobile ad hoc network which consists of highly mobile hosts that communicate via wireless links. Due to mobility, the topology of the network changes continuously and wireless links break down and reestablish frequently. Moreover, the ad hoc network operates in the absence of a fixed infrastructure forcing the hosts to organize the exchange of information decentrally. In this poster, we describe the formal system model and a localized group membership service for such an ad hoc network.

2 Group Membership Service

Chandra et al. [1] have proven the impossibility of providing a primary-partition group membership service in asynchronous systems with crash failures. However, distributed applications in spite of mobile hosts are prone to temporary disconnections. Therefore, recent work in group membership specification relaxes the strict demand for agreement on a single view and allows multiple disjoint views to exist concurrently.

We propose reducing the membership problem to the local environment of a host to cope with the severe conditions inherent in ad hoc networks. A localized group membership service (LGMS) tracks the membership only of the adjacent neighbors. Changes in the localized group membership – existent neighbors join or leave the group voluntarily or crash, new members move into vicinity – are installed as local views at each host. These views differ according to the neighborhood relation among vehicles.

The system model is asynchronous and consists of an unbounded but finite number of processes with unique identifiers. Inspired by the ability of failure detectors to maintain a list of processes suspected to be crashed or unreachable, we employ a heartbeat mechanism providing each process with a list of processes expected to be alive and its neighbors. On top of the neighborhood service (NHS), we design the LGMS as the properties **View Integrity**, **Limit on Neighborhood**, **View Accuracy**, **View Completeness**, and **View Installation**.

3 Work in Progress

By adding benign behavior to the system model, we hope to prove that a given implementation exhibits the properties of NHS and LGMS. With the application to traffic jam classification in mind, we will design a distributed algorithm working on top of the LGMS. Simulations will then show us, how well the system solves the given task.

References

[1] T. D. Chandra, V. Hadzilacos, S. Toueg, and B. Charron-Bost. On the impossibility of group membership. In *15th Annual ACM Symposium on Principles of Distributed Computing (PODC)*, pages 322–330, May 1996.

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