A Scalable Context-aware Solution for Inter-vehicle Communication

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Abstract. In a large scale network inter-vehicle communication leads towards a common concept known as 'telematics' which refers to the idea of vehicles equipped with smart computing devices with communication capabilities over certain networks. In this paper we present our relevance backpropagation algorithm for efficient context-aware inter-vehicle communication as prevailing P2P communication protocols and routing algorithms do not well serve the purpose. Our preliminary results show that relevance backpropagation decreases the communication overhead in a large scale vehicular network.

Keywords: Context-awareness, Scalability, Telematic, Inter-vehicle, Communication, Networks, Ubiquitous.

1 Introduction

In the ubiquitous computing paradigm, devices and applications are able to interact with one another and often have an awareness of the context of their users to create a smart environment that is proactive, dynamic and supportive. These applications are characterized by their ability to adapt their behavior to the ever changing environment in which they operate. Such dynamic settings with integrated information and communication technologies are found in intelligent transportation and traffic management systems, for example, which can also be referred to as Telematics. These applications employ wireless and sensor network technologies to create new opportunities for exchange of information within and between vehicles.

Intelligent large scale vehicular networks point towards many application areas such as emergency message transmission, collision avoidance, congestion monitoring and intelligent parking space location. The goal is to acquire relevant context information from other vehicles and manipulate this information to perform context-sensitive tasks. There is, however, a critical aspect in the development of such intelligent applications i.e. getting the *right information at the right time and place*. Current P2P communication protocols like Gossip, Pastry and Chord are not suitable for scalable context-aware information dissemination as the relevancy of information cannot be determined at intermediate nodes during interaction between several nodes and also no routing algorithm takes relevance of context into account. This is the focus of our research work.

2 Contributions and Outcome

In order to provide a solution to the problems mentioned earlier in section 1, we developed a relevance backpropagation algorithm [1] to enable scalable and efficient context-aware communication between vehicles so that only relevant information and services could be delivered to the interested nodes at right time and place. We also incorporated various versatile application requirements in our algorithm to ensure scalable context-aware communication which are as follows:

Spatial coverage: The application must not only take into account the geographic coverage area, but also efficiently route information to other vehicles within the network at a different location, velocity and direction where relevant e.g. in case of a car accident at a highway.

Timeliness of information: It is crucial that only up-to-date context information reaches its destination as it can lose relevance after a certain period of time e.g. free parking spot information.

Routing efficiency and efficacy: This parameter deals with the dynamic nature of the vehicular network and measures effectiveness inter-vehicle communication protocol aspects.

These aspects are integrated into our *Relevance backpropagation* algorithm which relies on feedback of neighboring nodes to reduce the number of peers to forward the information to. The information is initially forwarded to the adjacent nodes unless maximum number of hops is reached. Each forwarding node reduces the hop counter, adds its identification and marks the message relevancy tag if the information is relevant for its purpose. The feedback technique is based on context information like position, velocity, direction, time-to-live, interest etc that decides whether the data that was received is relevant or not and also help determine the information relevancy on the intermediate nodes. The feedback to the delivering node is initiated if the context information *is relevant, irrelevant*, *unused* or *duplicate information* is received reducing the information dissemination only to the interested nodes. A vehicular network is highly dynamic in nature and application dependent. As the context information can be provided by the application itself the routing of the information is adapted accordingly and perhaps different for various applications. So the network re-calibrates itself if a new node sends an *arrival beacon* or *an old node no longer transmits the feedback information*. In this mechanism the goal is to efficiently filter and route the relevant information as close to the source as possible in a dynamic network.

Our preliminary results show that relevance backpropagation decreases the communication overhead between the nodes in a large scale vehicular network [1].

References

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