Chapter 19
RFID Enabled Vehicular Network for Ubiquitous Travel Query

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ABSTRACT

Fixed infrastructure based wireless network is very expensive to provide total coverage and offer ubiquitous communication capacity. RFID enabled Vehicular Network emerges as an alternative which can leverage mobile nodes to bridge the gap between information isolated islands. The mobility and low duty cycle activity of nodes may destroy the network connectivity. This paper proposes RFID Enabled Vehicular Network for Ubiquitous Travel Query over Mobile Relay Network (MRN) to facilitate the needed information access for drivers on the road. The ubiquitous service is introduced and the performance of the successful information query is evaluated based on the computing model and network simulation. The results of evaluation and the real experiences of this service validate the feasibility of the system.

INTRODUCTION

Providing useful and timely travel information to passengers or traveler is very effective to eliminate unnecessary travel and optimize the traffics of transportation system. It can alleviate transportation congestion problems, control pollution, and improve transportation safety and security. Tremendous work has been done to look for viable solutions to realize travel information system in ITS. Such solutions and systems should be developed to be ubiquitous, cost-effective, efficient, and secure. Moreover, it is too expensive for fixed infrastructure based wireless network...
to provide total coverage and offer ubiquitous communication for travel information system.

Vehicular ad hoc Network (VANET) can leverage mobile nodes to bridge the gap between information isolated islands. It is a flexible and low-cost extension of wired infrastructure networks. With its ubiquitous feature, VANET is attracting intensive interests in many application areas. While in transportation system, transfer of data often have to be conducted when vehicles are connected intermittently. The vehicle with devices and communication equipment mounted move fast. The communication link is, thus, becoming highly dynamic and unstable. Especially, in rural area, mobile nodes, e.g., the vehicles, in the communication network may be also deployed sparsely. Even in dense deployment in the urban area, the communication paths change fast as well. In such scenarios, existence of end-to-end fully connected backbone is not the fact. Reliable communication that is subject to unpredictable connectivity due has long been recognized as a difficult task. Most of the communication protocols always assume that the network is fully connected and will fail to delivery any messages in case of the limited connectivity. In this paper we propose RFID Enabled Vehicular Network for Ubiquitous Travel Query (VUTQ) in Intelligent Transportation System over Mobile Relay Network (MRN) to facilitate the necessary information access for drivers on the road. We tackle with protocol design and evaluation for partial connectivity in VANET. We also introduce the development of travel information query application basing on MRN in ITS. A demonstration of travel information query service is provided.

RELATED WORK

Most of the communication protocols always assume that the network is fully connected. The protocol design and its evaluation research also focuses on this kind of networks. The application for this type of networks has not yet witnessed mass market deployment. The ongoing research and users demand is mainly focused on implementing real-time applications where high bandwidth and open access to the public Internet. However, there are many realistic scenarios in which many areas are with no preexisting communication infrastructure (e.g., disaster recovery and rural environments) (Bruno et al., 2005). In a transportation system the vulnerability of the communication links of ITS is inevitable. Trade-off should be dealt with between high responsiveness and the flexibility of the network.

If certain delay is tolerant, partially connected routing protocol can achieve successful packet forwarding in non-fully connected network (Burgess et al., 2006). In DTN (Delay-Tolerant Network) architecture, routing protocol can use store-wait-forward process to provide communication even if the end-to-end fully connected path never exists between the source the destination.

In ITS, the communication link is highly dynamic and unstable. Due to the high mobility and low duty cycle of communication link, the delay could vary. This kind of network is named Vehicular Sensor Network (VSN), which is a type of VANET (Burgess et al., 2006). For some applications which are not delay sensitive, such as traffic information query, environmental monitoring and event reporting, certain delay is tolerable, because late massage is much better than no message. The goal of such a network is to increase the probability of finding a path through an intermittently connected network. Traditional protocols resist on immediate forwarding policy and may fail due to the unpredictable delay. In the routing of VSN such as proposed in paper (Zhao & Cao, 2008), messages can be buffered for a certain amount of delay for later forwarding and be routed to the destination in tolerant delay.

There are many works on the evaluation of the connectivity availability of networks. In most of these works, the authors assume the constant connectivity availability without consideration
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