Chapter 49
Computing Traffic Information in the Cloud

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ABSTRACT

Vehicular ad hoc networks have been envisioned to be useful in road safety and commercial applications. In addition, in-vehicle capabilities could be used as a service to provide a variety of applications, for example, to provide real-time junction view of road intersections or to address traffic status for advanced traffic light control. In this work, the authors construct a cloud service over vehicular ad hoc networks to provide event data including capturing videos or Global Positioning System (GPS) data. Moreover, the authors integrate the GPS receiver and the navigation software equipped over On Board Unit to create a Geographic Information System digital map and to offer a traffic safety application. The hardware is implemented by Eeepad for integrating camera and GPS. Furthermore, the cyclic recording scheme has been addressed for data transmission and query. With the design, people can get real-time traffic information including traffic videos or geographical data in the cloud.

INTRODUCTION

The past few years, Intelligent Transportation Systems (ITS) and Vehicular Ad Hoc Networks (VANETs) have been widely adopted by using vehicles as network nodes to form a mobile network. VANET turns every participating car into a wireless router or node, allowing cars to connect with each other within approximately 100 to 300 meters apart from each other and to create a network with a wide range. One major goal of VANET deployment is to increase road safety and transportation efficiency (Biswas et al., 2006; Bai & Krishnan, 2006; Bohm & Jonsson, 2009). In order to enhance road safety and efficiency, many countries have allocated specific spectrum for communication. For example, in the U.S., the Federal Communications Commission (FCC) has allocated 75 MHz of spectrum in the 5.9-GHz band for dedicated short-range communications (DSRC). Vehicles transmit traffic related information to all reachable nodes based on broadcast

DOI: 10.4018/978-1-4666-6539-2.ch049

transmission. In safety applications, when a source node detects some incident or traffic congestion, it can generate a safety message to the succeeding vehicles by DSRC radios. The main content of safety messages contains real-time information to help drivers obtain the current traffic status.

With the increasing researches in VANET, there are various vehicular safety applications addressed and discussed with vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications (Spaho et al., 2011; Boeglen et al., 2011). Furthermore, a number of routing protocols for VANET have been proposed and evaluated. These evaluations often involve both vehicular and network simulators since the cost to evaluate a large number of real vehicular nodes is expensive. In these simulations, many authors proposed some mobility models (Camp et al., 2002; Bettstetter, 2001; Naumov et al., 2006) to simulate the world as real as possible. For example, random way point, random directions, and street random waypoint models have been proposed to simulate real vehicular traffics (Camp et al., 2002; Naumov et al., 2006). However, the performances heavily depended on the chosen mobility model. It indicates that there is not a standard mobility pattern for evaluating routing performance in VANETs. As a result, instead of simulations, we adopt the hardware with capability of communicating in DSRC radios to implement the system with low cost to realize VANET applications. Moreover, with the aid of portable navigation devices (PND) and smartphones, there are two benefits to design experiments in VANETs. One is to sense location-based information more easily. All the nodes equipped with GPS sensor could obtain their geographic information at any time. The other benefit is to visualize information in a handheld device. For example, the users could operate a digital map in an application to find locations of their friends.

Moreover, the Cloud computing (Jadeja & Modi, 2012; Baliga et al., 2011) technology utilizes ubiquitous and relatively low-cost high-speed Internet, virtualization and advances in parallel and distributed computing and distributed databases to give users the illusion of having infinite computing resources and the ability to pay for use of computing resources. There are three distinct types of cloud computing (Lu et al., 2011) defined as Infra-structure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). IaaS is that the cloud provider offers its customers with computing, network and storage resources. PaaS solutions are development platforms for which the development tool is hosted in the cloud and could be accessed through the network. With SaaS, a provider provides an application to customers as a service on demand.

The vehicular ad hoc networks perform a cloud network. With the services supported, the users could exchange real-time data like video captures in the intersection of roads or exchange some entertaining messages. In addition, the data is on-demand when the user requires the information. In Abuelela and Olariu (2010), Eltoweissy et al. (2010), the authors firstly introduce the vehicular cloud computing and categorize the main application of Cloud in VANET, e.g. Infra-structure as a Service (IaaS) in VANET where all the nodes provide customers with computing, network and storage resources. In Gongjun et al. (2012), the authors provided a conceptual overview of vehicular clouds and provided potential applications and illustrated challenges especially in security concerns. The authors provided some major design issues that will affect the implementations in vehicular cloud computing and analyzed the complexity. Instead of addressing the challenges and issues, we have cooperated with on board unit providers to design a system over vehicular networks. In this work, we not only realize the cloud in VANET but also implement the whole system for users.

The following summarizes the contribution of our works:

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