PROGRAMME

The Final Oral Examination
for the Degree of

DOCTOR OF PHILOSOPHY
(Computer Science)

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2010  China University of Geosciences          B. Eng.

“Realistic, Efficient and Secure Geographic Routing
In Vehicular Networks”

Thursday, February 26, 2015
10:00 a.m.
Engineering Office Wing, Room 430

Supervisory Committee:
Dr. Jianping Pan, Department of Computer Science, UVic
(Supervisor)
Dr. Kui Wu, Department of Computer Science, UVic
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Dr. Yin Lam, Department of Anthropology, UVic
Abstract

It is believed that the next few decades will witness the booming development of the Internet of Things (IoT). Vehicular network, as a significant component of IoT, has attracted lots of attention from both academia and industry in recent years. In the field of vehicular networks, Vehicular Ad hoc NETwork (VANET) is one of the hottest topics investigated. This dissertation focuses on VANET geocast, which is a special form of multicast in VANET. In geocast, messages are delivered to a group of destinations in the network identified by their geographic locations. Geocast has many promising applications, i.e., geographic messaging, geographic advertising and other location-based services. Two phases are usually considered in the geocast process: phase one, message delivery from the message source to the destination area by geographic routing; phase two, message broadcast within the destination area.

This dissertation covers topics in the two phases of geocast in urban VANETs, where for phase one, a data driven geographic routing scheme and a security and privacy preserving framework are presented; and for phase two, the networking connectivity is analyzed and studied. The contributions of this dissertation are threefold.

First, from a real-world data trace study, this work reveals the Markovian property of the city taxicab mobility. It proposes a mobility-contact-aware geocast scheme (GeoMobCon) for metropolitan-scale urban VANETs. The proposed scheme employs the node mobility (two levels, i.e., macroscopic and microscopic mobilities) and contact history information. A buffer management scheme is also introduced to further improve the performance.

Second, this dissertation investigates the connectivity of the message broadcast in urban scenarios. It models the message broadcast in urban VANETs as the directed connectivity problem on 2D square lattices and proposes an algorithm to derive the exact analytical solution. The approach is also applied to urban VANET scenarios, where both homogeneous and heterogeneous vehicle density cases are considered.

Third, this work focuses on the security and privacy perspectives of the opportunistic routing, which is the main technique utilized by the proposed geographic routing scheme. It proposes a secure and privacy preserving framework for the general opportunistic-based routing. And a comprehensive evaluation of the framework is also provided.

In summary, this dissertation focuses on a few important aspects of the two phases of VANET geocast in urban scenarios. It shows that the vehicle mobility and contact information can be utilized to improve the geographic routing performance for large-scale VANET systems. Targeting at the opportunistic routing, a security and privacy preserving framework is proposed to preserve the confidentiality of the routing metric information for the privacy purpose, and it also helps to achieve
the anonymous authentication and efficient key agreement for security purposes. On the other hand, the network connectivity for the message broadcast in urban scenarios is studied quantitatively with the proposed solution, which enables us to have a better understanding of the connectivity itself and its impact factors (e.g., bond probability and network scale).

**Awards, Scholarships, Fellowships**

2007  China National Scholarship  
2010-2014  China Scholarship Council-UVic Postgraduate Fellowship Program  
2012, 2013, 2014  UVic FGS/GSS Travel Grant  
2014  IEEE Student Travel Grant  

**Presentations**


4. **Lei Zhang**, “Metropolitan-Scale Taxicab Mobility Modeling,” IEEE Global Communications Conference (Globecom’12), Anaheim, California, USA, Dec. 3-7, 2012.


**Publications**

**Journal Papers**

Conference Papers


Submitted
