Title: Routing and Mobility in Vehicular Ad-hoc Networks

Introduction

Recently there has been an increasing interest in exploring the communication capabilities of transportation systems. Vehicles on the roads can form a Vehicular Ad-hoc Network (VANET) using wireless technology to communicate each other without any pre-deployed infrastructure. Such network not only can improve traffic safety efficiently but also provide the comfort applications to the passengers by multi-hop communications among vehicles. It is considered as one of the most prominent technologies in Intelligence Transportation Systems, and several research and industry projects of VANET have been initiated. As an application of Mobile Ad-hoc Networks (MANET), VANET shares some common characteristics with MANET, for example, limited bandwidth, multi-hop communications between mobile nodes and self-organization of them. In comparison with general MANET, VANET has higher and constrained mobility of nodes and more frequent changes of network topology, both of which can affect performance of routing protocol dramatically.

Objectives

The main objectives of this PhD Thesis is to optimize routing and mobility in VANETs. Routing in these environments will need to undertake a number of challenges. In this type of vehicular networks, several concepts are in place:

- ad-hoc movement and communication with significant speeds;
- delay tolerant networks, as communication will be only provided when there is connectivity, and then, information needs to be cached in the vehicular or infrastructure nodes and be opportunistically sent to the receiver nodes;
- moving networks, as groups of users will be mobility coordinated.

Moreover, in these networks it is also considered that there are heterogeneous connections, ad-hoc connections between the vehicles and the points of access to the infrastructure, and infrastructure (possible mesh based) connections between the several fixed points of access.

In this sense, a dynamic, cooperative and opportunistic routing mechanism needs to developed to cope with all these concepts and heterogeneity.

Considering mobility, beyond the widely known mobility mechanisms, several models for abstracting the location and focusing on networking between (mobile) hosts have been proposed. However, these architectures usually deal specifically with data-oriented networks, peer-to-peer systems and retrieval of information. Also, they are always addressing the scenario of infrastructure networks and are not adapted to multi-hop networks. IEEE is currently developing a new standard to enable handover and interoperability between heterogeneous network technologies, including both 802 and non 802 networks, the IEEE 802.21, to support efficient handovers between different technologies. This standard enables the support of media independent schemes to deal with the heterogeneity of access technologies, providing a unified control mobility layer. However, 802.21 is also not envisioned for multi-hop and self-organized communications, as the case of mesh networks. In wireless mesh networks, completely different mobility mechanisms have been developed, resorting to topology addressing structures to enhance the direct routing in mobility, or overcoming the direct routing requirement by using hybrid architectures. However, in this vehicular environment, with nodes interacting with fixed nodes (possibly in a mesh environment), it is crucial to develop a mobility framework that is able to provide the seamless movement of mobile nodes throughout the different stations and networks.

Advisory
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Research Institution
The work will be integrated in the Institute of Telecommunications – Aveiro.
Research group and interests:
The Multimedia and Communications Scientific Area inside Institute of Telecommunications in Aveiro contains a sub-area, which is mainly centred on architectures for Heterogeneous Networks. The main interests of this group are in the areas of integration of heterogeneous networks, covering both infrastructure, ad-hoc and mesh networks, and covering technologies such as WLAN, WiMax, DVB and Ethernet. The main areas of research consider issues such as Quality of Service (QoS), mobility, multicast and broadcast, security and privacy, inter-domain, communities, mobile GRIDs and IMS/MBMS integration.
This group participates in national and european projects. In particular, its current involvements are in the FP6 and FP7 Projects ***Daidalos***, ***C-Cast***, ***WIP***, ***4WARD***.