Chapter 8
Survey of Routing Protocols in Vehicular Ad Hoc Networks

Kevin C. Lee
UCLA, USA

Uichin Lee
UCLA, USA

Mario Gerla
UCLA, USA

ABSTRACT

The chapter provides a survey of routing protocols in vehicular ad hoc networks. The routing protocols fall into two major categories of topology-based and position-based routing. The chapter discusses the advantages and disadvantages of these routing protocols, explores the motivation behind their design and trace the evolution of these routing protocols. Finally, it concludes the chapter by pointing out some open issues and possible direction of future research related to VANET routing.

INTRODUCTION

With the sharp increase of vehicles on roads in the recent years, driving has not stopped from being more challenging and dangerous. Roads are saturated, safety distance and reasonable speeds are hardly respected, and drivers often lack enough attention. Without a clear signal of improvement in the near future, leading car manufacturers decided to jointly work with national government agencies to develop solutions aimed at helping drivers on the roads by anticipating hazardous events or avoiding bad traffic areas. One of the outcomes has been a novel type of wireless access called Wireless Access for Vehicular Environment (WAVE) dedicated to vehicle-to-vehicle and vehicle-to-roadside communications. While the major objective has clearly been to improve the overall safety of vehicular traffic, promising traffic management solutions and on-board entertainment applications are also expected by the different bodies (C2CCC[1], VII[2], CALM[3]) and projects (VICS[4] (Yamada, 1996), CarTALK 2000 (Reichardt D, 2002), NOW[5], CarNet (Morris R, 2000), FleetNet (Franz, 2001)) involved in this field.

When equipped with WAVE communication devices, cars and roadside units form a highly dynamic network called a Vehicular Ad Hoc Network (VANET), a special kind of Mobile Ad-Hoc

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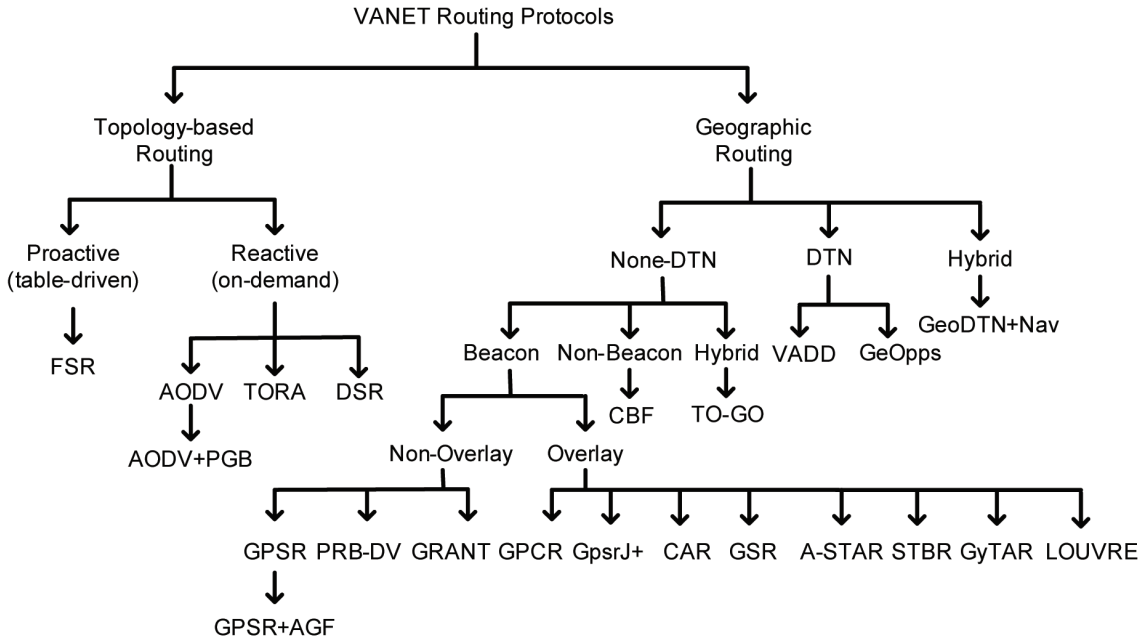
Figure 1. Taxonomy of various routing protocols in VANET



Networks (MANETs). While safety applications mostly need local broadcast connectivity, it is expected that some emerging scenarios (Lee, 2009) developed for intelligent transportation systems (ITS) would benefit from unicast communication over a multi-hop connectivity. Moreover, it is conceivable that applications that deliver contents and disseminate useful information can flourish with the support of multi-hop connectivity in VANETs.

Although countless numbers of routing protocols (Mauve, 2001; Mehran, 2004) have been developed in MANETs, many do not apply well to VANETs. VANETs represent a particularly challenging class of MANETs. They are distributed, self-organizing communication networks formed by moving vehicles, and are thus characterized by very high node mobility and limited degrees of freedom in mobility patterns.

As shown in Figure 1, there are two categories of routing protocols: topology-based and geographic routing. Topology-based routing uses the information about links that exist in the network to perform packet forwarding. Geographic routing uses neighboring location information to perform packet forwarding. Since link information changes in a regular basis, topology-based routing suffers from routing route breaks.

Despite many surveys already published on routing protocols in MANETs (Mauve, 2001; Mehran, 2004Giordano, 2003; Stojemnovic, 2004), a survey of newly developed routing protocols specific to VANETs has long been overdue. Li et al. (2007) have made an effort to introduce VANET routing protocols, yet there is still deficiency in a thorough and comprehensive treatment on this subject. A discussion of VANET topics and applications is incomplete without detailed coverage of relevant routing protocols and their impact on overall VANET architecture. In this book chapter, we seek to provide the missing building blocks by detailing the advances in VANET routing protocols. Section III describes