

Chapter 81

Cartography and Stability to Enhance and Self Regulate Proactive Routing in MANETs

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ABSTRACT

In this chapter, the authors propose a novel proactive routing protocol where routing advertisement frequency is self regulated locally at and by each node depending on its mobility level. The proposal relies on an asynchronous distributed cartography gathering algorithm and a link stability criterion. The cartography of the network is kept constantly valid in time and for all applied speeds. Each node senses its own dynamics and locally chooses an appropriate routing advertisement period size. As such stationary nodes generate little signaling traffic while fast moving nodes prefer small routing periods to mitigate the effect of their mobility.

INTRODUCTION

The performances of our proposed routing protocol are evaluated and compared to the known Optimized Link State Routing (OLSR) protocol through extensive simulations. We first show that the collected network cartography maintains over time a validity ratio near one hundred percent even for high node speeds. We then show that our proposed routing protocol provides around 97

percent routing validity while that of OLSR can hardly deliver more than 60 percent at moderate to high speeds and workloads. Finally, we show that our proposed protocol provides better throughput than OLSR reaching a 50% increase at moderate to high speeds and workloads and far much less end to end delays.

Routing in multi hop mobile ad hoc networks (MANETs) plays a central and vital role, yet it stands out as one of the most and fundamental issues to attain adequate performances and viable deployments. The crux of routing in such networks

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lies in its ability to maintain and provide valid routes without which traffic may wander inside the network without being able to be delivered to its ultimate destinations. Worse yet, on such invalid routes, the underlying Media Access Control (MAC) protocol retransmits unacknowledged unicast frames for several (by default seven) times which consequently amounts to over using the wireless communication medium and hence yields poor performances. We may stipulate here that the basic reason of the non proliferation of such spontaneous networks, despite their practical usefulness and need, is mainly due to their poor performances caused by the lack of viable low signaling and high validity routing algorithms.

In mobile ad hoc networks, nodes and links can appear and disappear spontaneously as a consequence of several facts such as the behavior of users, the depletion of energy resources, but more inherently and subtly the random mobility of the different nodes. These aspects imply a dynamically and randomly evolving topology in both time and space making the routing function a real difficult and challenging task. As a result, and as the elapsed time since the start of the routing period gets farther, the topological information collected at the beginning of the routing period becomes inaccurate and obsolete leading patently to invalid paths.

Conventional protocols, whether reactive - such as the Dynamic Source Routing (DSR) protocol (Johnson, Maltz and Yih-Chun Hu, 2004) and the Ad-hoc On-demand Distance Vector (AODV) routing protocol (Perkins, Royer and Chakeres, 2003) - or proactive - like OLSR (Clausen and Jacquet, 2003) and the Destination Sequenced Distance Vector (DSDV) routing protocol (Perkins and Bhagwat, 1999) -, use in general the hop-count metric to compute shortest paths towards destinations. However, shortest paths are not always reliable especially in case of dynamic networks. Finding stable routes is rather the main concern for dynamic multi-hop ad hoc networks. Several works already established that

choosing routes based on positions, battery level, etc. of the nodes would make selected paths more resilient to topological changes.

Numerous simulation studies were conducted on different scenarios to evaluate the performance of conventional protocols: for both proactive and reactive routing protocols as those conducted by Clausen, Jacquet and Viennot (2002), Novatnack, Greenwald and Arora (2005), or Mbarushimana Amine and Shahrabi (2002). Nevertheless, due to the huge number of relevant and complex events that can take place in mobile wireless ad hoc networks and their impacts on the performance of the protocols, results do not necessarily agree as to which protocol yields satisfying performances and lower control traffic and overhead. It is now understood that proactive protocols in particular, such as OLSR which is the main representative of this family, cannot withstand high mobility in an appropriate manner since the validity of the routes decreases rapidly as we get farther from the start of the routing period (Belghith and Abid, 2009-1, 2009-2).

In this paper, we propose a novel cartography-based protocol that builds the network cartography in an asynchronous distributed fashion, i.e., no synchronization is required among the nodes in the network. This network cartography provides better vision of the network connectivity and allows selecting viable links in a way that improves the routing pertinence as a function of the network dynamics. Yet, the signaling overhead required to build the network cartography and to establish the routing tables consumes less bandwidth than that of the well known and adopted OLSR. Our proposed routing protocol allows different nodes to have different routing period sizes. The size of the routing period adopted by a mobile node is decided locally and dynamically. Conducted simulations brought out the betterments achieved by our routing proposal in terms of a much better throughput, much less end to end delay and less signaling traffic rate than those provided using OLSR.

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