Period Size Self Tuning to Enhance Routing in MANETs

Mohamed Amine Abid, University of Manouba, Tunisia
Abdelfettah Belghith, University of Manouba, Tunisia

ABSTRACT

In this paper, the authors propose a novel routing protocol driven by an asynchronous distributed cartography gathering algorithm. Each node senses its own dynamics and chooses locally an appropriate routing period size. As such stationary nodes generate little signaling traffic; fast moving nodes choose small routing periods to mitigate the effect of their mobility. Moreover, every node integrates a self regulating process that dynamically and constantly calibrates the chosen routing period to track changes in its dynamics. The performances of this proposed routing protocol are evaluated and compared to the known Optimized Link State Routing (OLSR) protocol through extensive simulations. The paper shows that the collected network cartography maintains a validity ratio near 100% even for high node speeds. The authors illustrate that the proposed routing protocol provides around 97% routing validity while the OLSR can hardly deliver more than 60% at moderate to high speeds and workloads. Finally, the protocol provides better throughput than OLSR, reaching a 50% increase at moderate to high speeds and workloads less end-to-end delays.

Keywords: Location-Based Routing, MANETS, Network Cartography, Routing Validity, Stability-Based Routing

INTRODUCTION

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 lies in its ability to maintain and provide valid routes without which traffic may wander inside the networks 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 routing 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, & Yih-Chun, 2004) and the Ad-hoc On-demand Distance Vector (AODV) routing protocol (Perkins, Royer, & Chakeres, 2003) - or proactive - like OLSR (Clausen & Jacquet, 2003) and the Destination Sequenced Distance Vector (DSDV) routing protocol (Perkins & 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 MbarushimanaAmine and Shahrabi (2002). Nevertheless, due to the huge number of relevant and complex events that can take place in mobile wireless 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.

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.

The paper is organized as follows. First, we present some of the relevant research work done in the field. We then present a mechanism to collect the cartography of the network in a distributed way and that can be integrated to common proactive routing protocols. We then describe the routing protocol and its functioning. We also discuss the conducted simulations. We compare the results given by our proposed protocol to that of the OLSR (Clausen & Jacquet, 2003) routing protocol and we show the remarkable efficiency achieved by our proposal.

RELATED WORK

To withstand the network dynamics, stability-based routing is an approach aiming essentially at choosing routes which are more stable in time and hence more resilient to dynamic changes in the network topology.

In 2004, Chung proposed to classify links based on the mobility behavior of their end point nodes. Links between stationary or very slowly moving nodes are considered as stationary links. Links which exist only for a short period of time are handled as transient links. Newly formed
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