Abstract

Routing is one of the most important topics in the field of Ad-Hoc Networks. Kuhn and Wattenhofer have proven that when considering online routing strategies and radio holes in wireless Ad-Hoc Networks, one cannot do better than finding routing paths with quadratic competitiveness by only taking the geographic position of the source and the target node into account.
We propose a novel solution for dealing with radio holes in wireless Ad-Hoc Networks by adding information to the system to find paths with better competitive constants. The network structure is a Hybrid Communication Network in which nodes can communicate via their wireless channel over short distances as well as via a Cellular Infrastructure. Communication via their wireless channel is free (regarding money) whereas communication via the Cellular Infrastructure incurs costs. An Overlay Network built upon the Cellular Infrastructure enables us to obtain routing information for the Ad-Hoc Network.
We use bounding boxes to represent radio holes of the Ad-Hoc Network in the Overlay Network. Besides, we prove that we can find competitive paths between any source and target node of the Ad-Hoc Network that use nodes of bounding boxes as intermediate points. The competitive constant is 5.66 for non-intersecting bounding boxes. Moreover, we argue that the knowledge about bounding box nodes is not enough to find competitive paths in scenarios with intersecting bounding boxes. Therefore, we propose an idea to enrich information obtained by bounding boxes such that we can find competitive paths in scenarios with intersecting bounding boxes and prove a competitive constant of 12.83.
Further, we introduce BoBOSPA, a self-stabilizing Overlay Network that contains all information to find competitive paths using nodes of bounding boxes as intermediate points. Besides, we prove that BoBOSPA can be built for non-intersecting bounding boxes in $\mathcal{O}(\log^2 n)$ communication rounds with high probability, assuming that the Ad-Hoc Network has already reached a stable state. When considering intersecting bounding boxes, the number of communication rounds is proven to be $\mathcal{O}(n)$.