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Self-stabilizing spanner topology control solutions in wireless ad hoc networks ☆

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ABSTRACT

Large-scale, self-organizing wireless ad hoc network deployments are being driven by recent developments of the Internet of Things (IoT) to collect information from a vast area or harsh environment efficiently. How to ensure fast routing in sparse topology and after node failure how to ensure that the network keeps topology properties are challenging problems. In this paper, we propose a Self-stabilizing dIrected t-Spanner for Autonomous nodes problem (SISA) and give intuitive solutions in both 2D and 3D space. In the topology construction phase, sparse directed t-spanner topologies, without substantially degrading the path connecting any pair of nodes in the original network, are constructed with a minimum number of messages. In the topology maintenance phase, the self-stabilizing algorithms run in the background to update locally for keeping t-spanner property when some nodes fail. In particular, our solutions have not any central daemon and are completely distributed. Our experimental results demonstrate the effectiveness and efficiency of our proposed solutions.

1. Introduction

The front-end of the Internet of Things (IoT) is often formed by large-scale wireless ad hoc networks which used to collect information from a wide area, or harsh environment [2]. Such an infrastructure-free wireless ad hoc network may consist of a few hundreds or even thousands of autonomous nodes with low power equipped [3]. These nodes may deploy in a two-dimensional place (2D) or more in a three-dimensional place (3D). In traditional ad hoc networks, all the nodes are equal, i.e., they take part in the routing and forwarding packets equally.

Hence how to achieve the objectives of reducing energy consumption and efficient routing becomes an urgent and ongoing challenge [4]. Topology control (TC) technology that reduces links and maintains specific characteristics can address the above challenge. TC can be divided into two phases [5]: topology construction and topology maintenance. Topology

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