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Detection of Cut in Wireless Sensor Networks

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ABSTRACT: A wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "cut". In this article we consider the problem of detecting cuts by the remaining nodes of a wireless sensor network. We propose an algorithm that allows (i) every node to detect when the connectivity to a specially designated node has been lost, and (ii) one or more nodes (that are connected to the special node after the cut) to detect the occurrence of the cut. The algorithm is distributed and asynchronous: every node needs to communicate with only those nodes that are within its communication range. The algorithm is based on the iterative computation of a fictitious "electrical potential" of the nodes. The convergence rate of the underlying iterative scheme is independent of the size and structure of the network.

Keywords: WMAX, CCOS, TOPLOGY

INTRODUCTION:

Wireless sensor networks (WSNs) are a promising technology for monitoring large regions at high spatial and temporal resolution. In fact, node failure is expected to be quite common due to the typically limited energy budget of the nodes that are powered by small batteries. Failure of a set of nodes will reduce the number of multi-hop paths in the network. Such failures can cause a subset of nodes – that have not failed – to become disconnected from the rest, resulting in a "cut". Two nodes are said to be disconnected if there is no path between them.

We consider the problem of detecting cuts by the nodes of a wireless network. We assume that there is a specially designated node in the network, which we call the *source node*. The source node may be a base station that serves as an interface between the network and its users. Since a cut may or may not separate a node from the source node, we distinguish between two distinct outcomes of a cut for a particular node. When a node u is disconnected from the source, we say that a DOS (Disconnected from Source) event has occurred for u. When a cut occurs in the network that does not separate a node u from the source node, we say that CCOS (Connected, but a Cut Occurred Somewhere) event has occurred for u. By cut detection we mean (i)detection by each node of a DOS event when it occurs, and (ii) detection of CCOS events by the nodes close to a cut, and the approximate location of the cut. By "approximate location" of a cut we mean the location

of one or more active nodes that lie at the boundary of the cut and that are connected to the source. Nodes that detect the occurrence and approximate locations of the cuts can then alert the source node or the base station.

To see the benefits of a cut detection capability, imagine that a sensor that wants to send data to the source node has been disconnected from the source node. Without the knowledge of the network's disconnected state, it may simply forward the data to the next node in the routing tree, which will do the same to its next node, and so on. However, this message passing merely wastes precious energy of the nodes; the cut prevents the data from reaching the destination. Therefore, on one hand, if a node were able to detect the occurrence of a cut, it could simply wait for the network to be repaired and eventually reconnected, which saves onboard energy of multiple nodes and prolongs their lives. On the other hand, the ability of the source node to detect the occurrence and location of a cut will allow it to undertake network repair. Thus, the ability to detect cuts by both the disconnected nodes and the source node will lead to the increase in the operational lifetime of the network as a whole. A method of repairing a disconnected network by using mobile nodes has been proposed in [1]. Algorithms for detecting cuts, as the one proposed here, can serve as useful tools for such network repairing methods. A review of prior work on cut detection in sensor networks, e.g. [2], [3], [4] and others, is included in the Supplementary Material.

In this article we propose a distributed algorithm to detect cuts, named the *Distributed Cut Detection* (DCD) algorithm. The algorithm allows each node to detect DOS events and a subset of nodes to detect CCOS events. The algorithm we propose is distributed and asynchronous: it involves only local communication between neighboring nodes, and is robust to temporary communication failure between node pairs. A key component of the DCD algorithm is a distributed iterative computational step through which the nodes compute their (fictitious) electrical potentials. The convergence rate of the computation is independent of the size and structure of the network.

The DOS detection part of the algorithm is applicable to arbitrary networks; a node only needs to communicate a scalar variable to its neighbors. The CCOS detection part of the algorithm is limited to networks that are deployed in 2D Euclidean spaces, and nodes need to know their own positions. The position information need not be highly accurate. The proposed algorithm is an extension of our previous work [5], which partially examined the DOS detection problem.

PROPOSED SYSTEM:

Wireless sensor networks (WSNs) are a promising technology for monitoring large regions at high spatial and temporal resolution .Failure of a set of nodes will reduce the number of multi-hop paths in the network. Such failures can cause a subset of nodes – that have not failed – to become disconnected from the rest, resulting in a "cut". Two nodes are said to be disconnected if there is no path between them. We consider the problem of detecting cuts by the nodes of a wireless network. We assume that there is a specially designated node in the network, which we call the *source node.* Since a cut may or may not separate a node from the source node, we distinguish between two distinct outcomes of a cut for a particular node. When a node u is disconnected from the source, we say that

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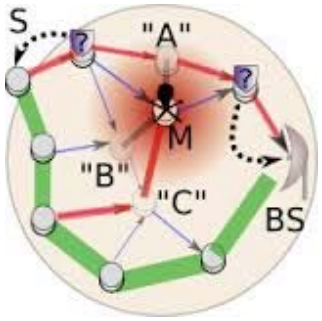
it occurs, and (ii) detection of CCOS events by the nodes close to a cut, and the approximate location of the cut. In this article we propose a distributed algorithm to detect cuts, named the *Distributed Cut Detection* (DCD) algorithm. The algorithm allows each node to detect DOS events and a subset of nodes to detect CCOS events. The algorithm we propose is distributed and asynchronous: it involves only local communication between neighboring nodes, and is robust to temporary communication failure between node pairs The convergence rate of the computation is independent of the size and structure of the network.



CONCLUSION:

We presume that, The WMAX calculation we propose here empowers each hub of a remote sensor system to identify detached from source occasion in the event that they happen. Second, it empowers the subset of hubs that encounters CCOS occasion to recognize them and appraisal the rough area of the cut as a rundown of dynamic hubs that lie at the limit of the cut/gap. A key quality of the WMAX calculation is that the merging rate of the basic iterative plan is entirely quick and free of the size and structure of the system, which makes location utilizing this calculation very fast[5].

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