# Cut Detection and Prevention in Wireless Sensor Network

**Sonali Parmar, Kavita Shevale, Kajal Wakhare, Neha Rudrakanthwar**

*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 paper, we consider the problem of detecting cuts by the remaining nodes of a wireless sensor network. Wireless Sensor Network (WSN) is made up of few or large number of sensor nodes and one sink node. One of the crucial challenges in WSN is cut generation instead of increase the life sensor node. Sensor node is small device made up of three basic units as sensor unit, processing unit and wireless communication (transceiver) unit equipped with limited power supply through batteries. Since the node has limited energy supply, these nodes are put in sleep mode to conserve energy which helps to prolong network life. In this paper we will discuss sleep scheduling based energy conservation protocol using broadcast tree used to save battery of sensor nodes. In tree sink node act as root node and the nodes with higher energy acts as branch node and node with low energy acts as leaf node. The leaf nodes are put to sleep and branch node remains awake. The tree is reconstructed periodically to balance energy in all nodes. Fault-tolerance in network is achieved by keeping two paths from each node to sink node. Base on the existing system we can prevent the cuts in network.**

*Index Terms*— **Detection and estimation, iterative computation, sensor networks, wireless networks.**

## I. INTRODUCTION

Wireless sensor networks (WSNs) are a promising technology for monitoring large regions at high spatial and temporal resolution. However, the small size and low cost of the nodes that makes them attractive for widespread deployment also causes the disadvantage of low-operational reliability. A node may fail due to various factors such as mechanical/electrical problems, environmental degradation, battery depletion, or hostile tampering. 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 multihop 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 Disconnected frOm Source (DOS) 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 Connected, but a Cut Occurred Somewhere (CCOS) event has occurred for u. By cut detection we mean 1) detection by each node of a DOS event when it occurs, and 2) 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 on-board 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].

## II. DISTRIBUTED CUT DETECTION ALGORITHM

### *A. DOS*

Time is measured with a discrete counter $k = -\infty. . .-1,0,1, 2, . . .$ We model a sensor network as a time-varying graph $G(k)=(V(k), E(k))$, whose node set $V(k)$ represents the sensor nodes active at time k and the edge set $E(k)$ consists of pairs of nodes (u, v) such that nodes u and v can directly exchange messages between each other at time k. By an active node we mean a node that has not failed permanently. All graphs

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considered here are undirected, i.e., (i, j) = (j, i). A path from i to j is a sequence of edges connecting i and j.

In terms of these definitions, a cut event is formally defined as the increase of the number of components of a graph due to the failure of a subset of nodes (as depicted in Fig. 1). The number of cuts associated with a cut event is the increase in the number of components after the event. The problem we seek to address is twofold. First, we want to enable every node to detect if it is disconnected from the source (i.e., if a DOS event has occurred). Second, we want to enable nodes that lie close to the cuts but are still connected to the source (i.e., those that experience CCOS events) to detect CCOS events and alert the source node.

There is an algorithm-independent limit tohow accurately cuts can be detected by nodes still connected to the source, which are related to holes. Fig. 1 provides a motivating example.

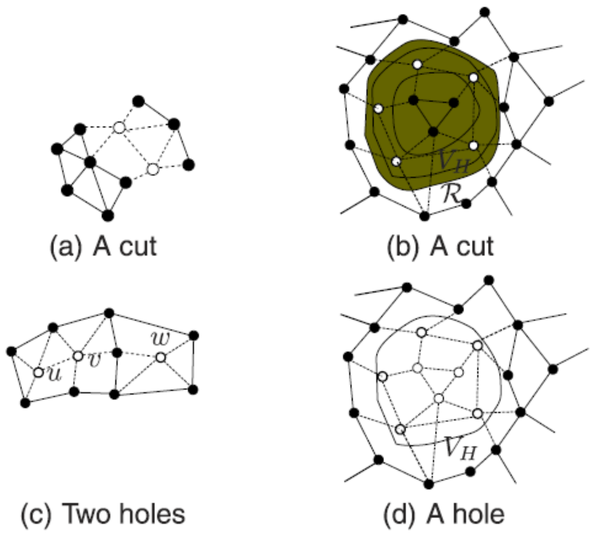


Fig. 1. Examples of cuts and holes. Filled circles represent active nodes and unfilled filled circles represent failed nodes. Solid lines represent edges, and dashed lines represent edges that existed before the failure of the nodes. The hole in (d) is indistinguishable from the cut in (b) to nodes that lie outside the region R.

### *A. CCOS*

The algorithm for detecting CCOS events relies on finding a short path around a hole, if it exists, and is partially inspired by the jamming detection algorithm proposed in. The method utilizes node states to assign the task of hole-detection to the most appropriate nodes. When a node detects a large change in its local state as well as failure of one or more of its neighbors, and both of these events occur within a (predetermined) small time interval, the node initiates a PROBE message. Each PROBE message p contains the following information:

## III. Mathematical Module

INPu = {Requested user for data}
DBp = {Data providers upto n}
Fb = {INPu^DBp}
Since,
Input give to any= {DBp} // it should be DDL, DML, DCL commands
Output = {Fb} // it should be a data table

Success Condition,
INPu $\neq$ |INPu| $\neq$NULL
DBp$\neq$|DBp|$\neq$NULL
Failure Condition,
if(F(i))
{
n[i]=NULL;
}//user not available in database authentication time

INPu[i] = =NULL, DBp [i]= =NULL

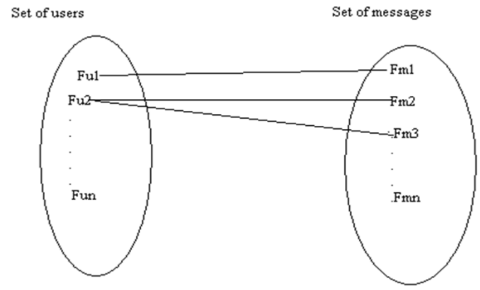


Fig. 2. Mapping between set of messages and set of uses to be send

## IV. Architecture

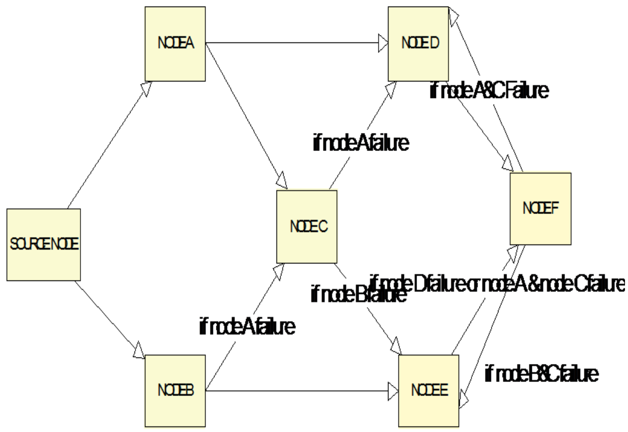

Fig. 3. Archiitecture

## V. Existing And Proposed System

### *A. Existing system*

Wireless Multimedia Sensor Networks (WMSNs) has many challenges such as nature of wireless media and multimedia information transmission. Consequently traditional mechanisms for network layers are no longer acceptable or applicable for these networks. Wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "cut". Existing cut detection system deployed only for wired networks.

### *B. Proposed system*

Wireless Multimedia Sensor Networks (WMSNs) has many challenges such as nature of wireless media and multimedia information transmission. Consequently traditional mechanisms for network layers are no longer acceptable or applicable for these networks. Wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "cut". Existing cut detection system deployed only for wired networks.Conclusion

## VI. Feasibity Study

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.Three key considerations involved in the feasibility analysis are

- Economical feasibility

  This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

- Social feasibility

  The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

- Technical feasibility

  This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

## VII. Literature Survey

### 1. An Algorithm for Reconnecting Wireless Sensor Network Partitions

**Authors:** G. Dini, M. Pelagatti, and I.M. Savino

In a Wireless Sensor Network, sensor nodes may fail for several reasons and the network may split into two or more disconnected partitions. This may deteriorate or even nullify the usefulness and effectiveness of the network. Therefore, repairing partitions is a priority. In this paper we present a method to repair network partitions by using mobile nodes. By reasoning upon the degree of connectivity with neighbours, a mobile node finds the proper position where to stop in order to re-establish connectivity. Factors influencing the method performance are singled out and criteria for their selection are discussed. Simulations show that the proposed method is effective and efficient notwithstanding packet loss.

### 2. Detecting Cuts in Sensor Networks

**Authors**: N. Shrivastava, S. Suri, and C.D. To´ th

We propose a low overhead scheme for detecting a network partition or cut in a sensor network. Consider a network S of n sensors, modeled as points in a two-dimensional plane. An ε-cut, for any $0 < \varepsilon < 1$, is a linear separation of εn nodes in S from a distinguished node, the base station. We show that the base station can detect whenever an ε-cut occurs by monitoring the status of just O ( 1) nodes in the network. ε Our scheme is deterministic and it is free of false positives: no reported cut has size smaller than 1 εn. Besides this combinatorial result, we also 2 propose efficient algorithms for finding the O ( 1) nodes that should act ε as sentinels, and report on our simulation results, comparing the sentinel algorithm with two natural schemes based on sampling

### 3. A Partition Detection System for Mobile Ad-hoc Networks

**Authors**: H. Ritter, R. Winter, and J. Schiller

A vast amount of applications and mechanisms recently developed for mobile ad-hoc networks could greatly benefit from the utilization of network status information. That includes, but is not limited to the detection of network partitioning. Network partitioning is a form of network failure. A single connected network topology breaks apart into two or more network topologies separated from each other. The simulations show that both approaches detect partitioning reliably, with both having unique advantages.

### 4. Partition Detection in Mobile Ad-Hoc Networks

**Authors:** M. Hauspie, J. Carle, and D. Simplot

A vast amount of applications and mechanisms recently developed for mobile ad-hoc networks could greatly benefit from the utilization of network status information. That includes, but is not limited to the detection of network partitioning. Network partitioning is a form of network failure. A single connected network topology breaks apart into two or more network topologies separated from each other. The simulations show that both approaches detect partitioning reliably, with both having unique advantages.

### 5. Distributed Cut Detection in Sensor Networks

**Authors:** P. Barooah

We propose a distributed algorithm to detect cuts in sensor networks, i.e., the failure of a set of nodes that separates the networks into two or more components. The algorithm consists of a simple iterative scheme in which every node updates a scalar state by communicating with its nearest neighbors. In the absence of cuts, the states converge to values that are equal to potentials in a fictitious electrical network. When a set of nodes gets separated from a special node, that we call a source node, their states converge to 0 because current is extracted from the component but none is injected.

## VIII. System Features

### *A. Distributed cut detection*

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.

*B. Cut*

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.

*C. Source node*

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.

*D. CCOS And DOS*

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.

*E. Network separation*

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”. Because of cut, some nodes may separated from the network, that results the separated nodes can’t receive the data from the source node.

## IX. CONCLUSION

The DCD algorithm we propose here enables every node of a wireless sensor network to detect Disconnected from Source events if they occur. Second, it enables a subset of nodes that experience CCOS events to detect them and estimate the approximate location of the cut in the form of a list of active nodes that lie at the boundary of the cut/hole. The DOS and CCOS events are defined with respect to a specially designated source node. The algorithm is based on ideas from electrical network theory and parallel iterative solution of linear equations.

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