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FAILURE DETECTION UNRECOVERING IN MOBILE WIRELESS NETWORKS

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Abstract:

This system introduces a distributed fault-tolerant topology control algorithm, called the Disjoint Path Vector (DPV), for heterogeneous wireless sensor networks composed of a large number of sensor nodes with limited energy and computing capability and several super nodes with unlimited energy resources. The DPV algorithm addresses the k-degree any cast Topology Control problem where the main objective is to assign each sensor's transmission range such that each has at least k-vertex-disjoint paths to super nodes and the total power consumption are minimum. The resulting topologies are tolerant to k 1 node failures in the worst case. We prove the correctness of our approach by showing that topologies generated by DPV are guaranteed to satisfy k-vertex super node connectivity. Our simulations show that the DPV algorithm achieves up to 4-fold reduction in total transmission power required in the network and 2-fold reduction in maximum transmission power required in a node compared to existing solutions.

Index Terms: Fault Tolerance, K-Connectivity, Disjoint Paths, Heterogeneous Wireless Sensor Networks, Energy Efficiency

1. Introduction:

Wireless sensor networks (WSNs) have been studied extensively for their broad range of potential monitoring and tracking applications, including environmental monitoring, battlefield surveillance, health care solutions, traffic tracking, smart home systems and many others. Power efficiency and fault tolerance are essential properties to have for WSNs in order to keep the network functioning properly in case of energy depletion, hardware failures, communication link errors, or adverse environmental conditions, events that are likely to occur quite frequently in WSNs.

Topology control is one of the most important techniques used for reducing energy consumption and maintaining network connectivity. This paper introduces a new algorithm called the Disjoint Path Vector (DPV) algorithm for constructing a fault-tolerant topology to route data collected by sensor nodes to super nodes. In WSNs, guaranteeing k-connectivity of the communication graph is fundamental to obtain a certain degree of fault tolerance. The resulting topology is tolerant up to k - 1 node failures in the worst case. We propose a distributed algorithm, namely the DPV algorithm, for solving this problem in an efficient way in terms of total transmission power of the resulting topologies, maximum transmission power assigned to sensor nodes, and total number of control message transmissions. Our simulation results show that our DPV algorithm achieves between 2.5-fold and 4-fold reduction in total transmission power required in the network, depending on the packet loss rate, and a 2-fold reduction in maximum transmission power required in a node compared to existing solutions. The power efficiency of our algorithm directly results from the novel approach that we apply while discovering the disjoint paths.

Power efficiency and fault tolerance are essential properties to have for WSNs in order to keep the network functioning properly in case of energy depletion, hardware failures, communication link errors, or adverse environmental conditions, events that are likely to occur quite frequently in WSNs [2], [3]. Topology control is one of the most important techniques used for reducing energy consumption and maintaining network connectivity [4]. There are many reactive and proactive topology control techniques for tolerating node failures in WSNs.

2. Related Works:

Wireless sensor networks (WSNs) have been studied extensively for their broad range of potential monitoring and tracking applications, including environmental monitoring, battlefield surveillance, health care solutions, traffic tracking, smart home systems and many others [1].

WSNs are typically composed of large number of tiny sensors that are capable of sensing, processing and transmitting data via wireless links. Power efficiency and fault tolerance are essential properties to have for WSNs in order to keep the network functioning properly in case of energy depletion, hardware failures, and communication link errors. Topology control is one of the most important techniques used for reducing energy consumption and maintaining network connectivity. Links between super nodes have longer ranges and higher data rates; however, super nodes are fewer in number due to their higher cost. A heterogeneous WSN with super nodes are known to be more reliable and have longer network lifetime than the homogeneous 27 counterparts without super nodes. Heterogeneity can triple the average delivery rate and provide a five-fold increase in the network lifetime if super nodes are deployed carefully.

The resulting topology is tolerant up to k-1 node failures in the worst case. We propose a distributed algorithm, namely the DPV algorithm, for solving this problem in an efficient way in terms of total transmission power of the resulting topologies, maximum transmission power assigned to sensor nodes, and total number of control message transmissions. Our simulation results show that our DPV algorithm achieves between 2.5-fold and 4-fold reduction in total transmission power required in the network, depending on the packet loss rate, and a 2-fold reduction in maximum transmission power required in a node compared to existing solutions. The power efficiency of our algorithm directly results from the novel approach that we apply while discovering the disjoint paths.

Disjoint Path Vector Algorithm:

Our algorithm is based on the observation that for a node we can remove the edges with neighbors that are not on one of the k-vertex disjoint paths from the node to one of the super nodes. To achieve this, we need to determine which neighbors are on one of such paths and which are not. Our DPV algorithm finds a superset of the required vertices in order to guarantee the k-vertex super node connectivity. Having found the required neighbors, each node removes edges not connected to a required node in coordination with its neighbors.

Then, to save energy, we decrease the transmission range of the sensor nodes but still reach the farthest node in the new set of neighbors. DPV is a distributed algorithm executed by each sensor node in the network. Each node uses topology information in its 1-hop neighborhood. Paths to the super nodes are explored using messages, which contain path information from a super node to a sensor node. Global network topology information is not required by the DPV algorithm.

3. Proposed Work:

This paper introduces a new algorithm called the Disjoint Path Vector (DPV) algorithm for constructing a fault-tolerant topology to route data collected by sensor nodes to super nodes. In WSNs, guaranteeing k-connectivity of the communication graph is fundamental to obtain a certain degree of fault tolerance. The resulting topology is tolerant up to k - 1 node failures in the worst case. We propose a distributed algorithm, namely the DPV algorithm, for solving this problem in an efficient way in terms of total transmission power of the resulting topologies, maximum transmission power assigned to sensor nodes, and total number of control message transmissions.

Our simulation results show that our DPV algorithm achieves between 2.5-fold and 4-fold reduction in total transmission power required in the network, depending on the packet loss rate, and a 2-fold reduction in maximum transmission power required in a node compared to existing solutions. The power efficiency of our algorithm directly results from the novel approach that we apply while discovering the disjoint paths. This approach involves in storing full path information instead of just next node information on the paths and provides a large search scope for discovering the best paths throughout the network without the need of global network topology.

Advantages:

- ✓ Route data collected by sensor nodes to super nodes
- ✓ Guaranteeing k-connectivity
- ✓ Maximize the transmission power
- ✓ Packet scheduling rate also high
- ✓ Node failure or route failure also recovered

Module:

- ✓ Network Module
- ✓ Data Replication
- ✓ The One-To-One Optimization (OTOO) Scheme
- ✓ Route Vulnerability Metric (RVM)
- ✓ Reliable Grouping (RG) Scheme

Network Module: Client-server computing or networking is a distributed application architecture that partitions tasks or workloads between service providers (servers) and service requesters, called clients. Often clients and servers operate over a computer network on separate hardware. A server machine is a high-performance host that is running one or more server programs which share its resources with clients. A client also shares any of its resources; Clients therefore initiate communication sessions with servers which await (listen to) incoming requests.

Data Replication: Data replication has been extensively studied in the Web environment and distributed database systems. However, most of them either do not consider the storage constraint or ignore the link failure issue. Before addressing these issues by proposing new data replication schemes, we first introduce our system model. In a MANET, mobile nodes collaboratively share data. Multiple nodes exist in the network and they send query requests to other nodes for some specified data items. Each node creates replicas of the data items and maintains the replicas in its memory (or disk) space. During data replication, there is no central server that determines the allocation of replicas, and mobile nodes determine the data allocation in a distributed manner.

The One-To-One Optimization (OTOO) Scheme: It considers the access frequency from a neighboring node to improve data availability. It considers the data size. If other criteria are the same, the data item with smaller size is given higher priority for replicating because this can improve the performance while reducing memory space. It considers the impact of data availability from the neighboring node and link quality. Thus, if the links between two neighboring nodes are stable, they can have more cooperation's in data replication.

Route Vulnerability Metric (RVM):

We define a class of route vulnerability metrics (RVMs) to quantify the effective security of traffic traversing a given route. Using the RVM definition, we formulate the minimum cost node capture attack problem as a nonlinear integer programming minimization problem. Since determining the optimal node capture attack is likely infeasible, we propose the GNAVE algorithm using a greedy heuristic to iteratively capture nodes which maximize the increase in route vulnerability.

Reliable Grouping (RG) Scheme:

OTOO only considers one neighboring node when making data replication decisions. RN further considers all one-hop neighbors. However, the cooperation's in both OTOO and RN are not fully exploited. The basic idea of the RG scheme is that it always picks the most suitable data items to replicate on the most suitable nodes in the group to maximize the data availability and minimize the data access delay within the group.

4. Experimental Analysis and Results:

WIRELESS sensor networks (WSNs) have been studied extensively for their broad range of potential monitoring and tracking applications, including environmental monitoring, battlefield surveillance, health care solutions, traffic tracking, smart home systems and many others [1]. WSNs are typically composed of large number of tiny sensors that are capable of ensing, processing and transmitting data via wireless links. Power efficiency and fault tolerance are essential properties to have for WSNs in order to keep the network functioning properly in case of energy depletion, hardware failures, and communication link errors]. There are many reactive and proactive topology control techniques for tolerating node failures in WSNs [37]. Links between super nodes have longer ranges and higher data rates; however, super nodes are fewer in number due to their higher cost.

A heterogeneous WSN with super nodes are known to be more reliable and have longer network lifetime than the homogeneous. Counter parts without super nodes. This paper introduces a new algorithm called the Disjoint Path Vector (DPV) algorithm for constructing a fault-tolerant topology to route data collected by sensor nodes to super nodes. In WSNs, guaranteeing k-connectivity of the communication graph is fundamental to obtain a certain degree of fault tolerance [4].

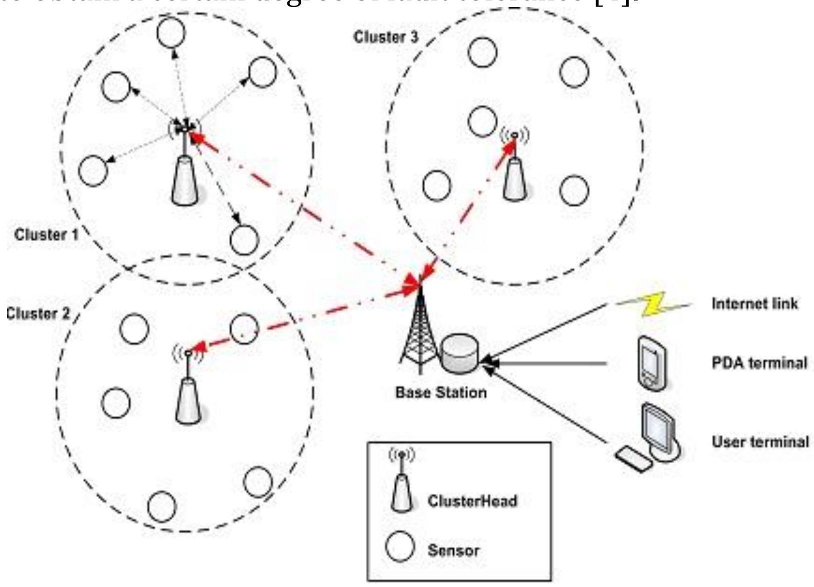
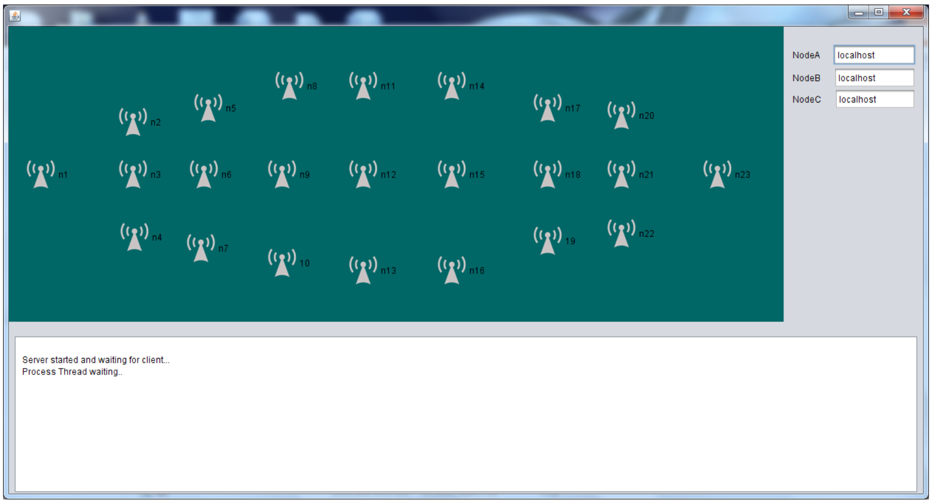


Figure 1: Clustered Sensor Network

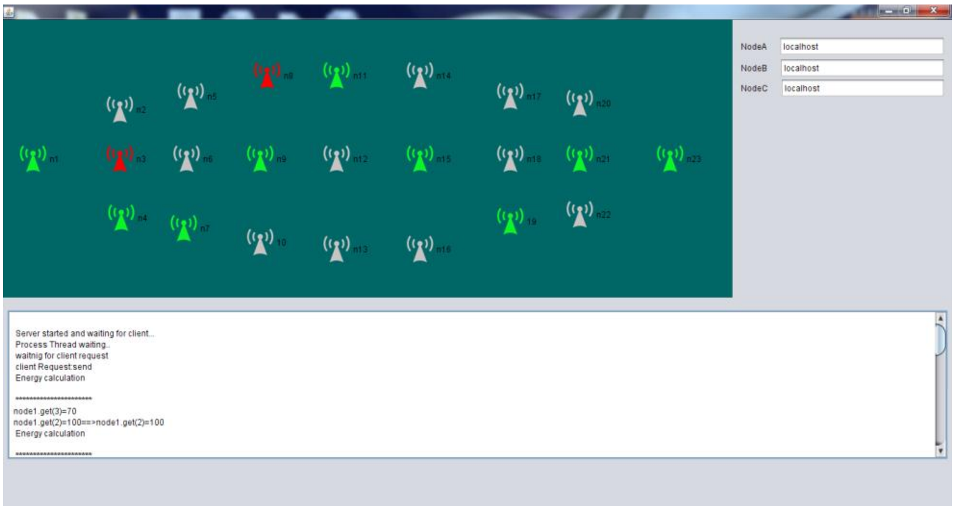
Simulation Process:



The resulting is a distributed algorithm, namely the DPV algorithm, for solving this problem in an efficient way in terms of total transmission power of the resulting topologies, maximum transmission power assigned to sensor nodes, and total number of control message transmissions.

Our simulation results show that our DPV algorithm achieves between 2.5-fold and 4-fold reduction in total transmission power required in the network, depending on the packet loss rate, and a 2-fold reduction in maximum transmission power required in a node compared to existing solutions. The power efficiency of our algorithm directly results from the novel approach that we apply while discovering the disjoint paths.

Final Simulation Process:



5. Conclusion:

Our algorithm results in topologies where each sensor node in the network has at least k-vertex disjoint paths to the super nodes. The nodes in the network. Compared to an existing solution, the DATC algorithm, DPV algorithm achieves a 4-fold reduction in total transmission power and a 2-fold reduction in maximum transmission power under the assumption of no packet losses. When we consider the packet losses, 2.5-fold reduction in total power consumption can be achieved for a packet loss rate of 0.1.In addition; DPV achieves these results by requiring fewer message transmissions and receptions than DATC. The solution that we propose is, however, distributed and localized, thus is scalable to large networks and therefore suitable for use in real applications.

6. Future Enhancement:

There are many protocols but have to be compared. Many factors but can affect the lifetime of WSN should be considered be plan to do gives comparison and analysis in our future work.

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