Toward Power Optimization for Communication Failure Recovery in Body Sensor Networks

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ABSTRACT

Body Sensor Networks (BSNs) have proven effective in improving quality of medical services by providing continuous and ambulatory healthcare monitoring. Realistic system often employ collaborative sensor models. Due to the data interdependencies, brief unavailability of a small portion of data can invalidate a whole period of observation. To address this issue we present our ongoing research on minimum energy cost recovery from link failures.

1. INTRODUCTION

There is a variety of factors that may cause delay or loss of a small portion of data, such as hardware failures, communication interference, and environmental conditions. These issues are further severed by limited resources of BSN nodes, which are defined by multiple constraints associated with wearable sensor systems [2]. For the system to be successful, it is very important that sensor nodes do not alter the normal behavior of the subjects. As a result, the main system constraint is wearability. Size and portability, two main wearability factors, introduce multiple hardware constraints; as a result nodes are normally powered by a small battery, have limited amount of processing power and memory, and communicate wirelessly within a short distance. The network lifetime can be defined in terms of the power consumption of the system. Thus, it is desirable to decrease the amount of power consumed by the sensor nodes to increase the system lifetime during the normal operation as well as failure recovery.

When a link failure occurs in the network, a subset of data dependencies are severed, while all computations are still intact. We aim to preserve the integrity of the computation by backing up the data, which is required to restart the original computation once the link failure is rectified. The backup data can be stored locally, or it can be forwarded to another node via wireless. [3] shows that storing data locally requires much less energy than a wireless transmission. Therefore, storing data locally comes virtually at no energy cost. However, once the node no longer has any available memory for the backup it is forced to send data out. The cost of sending data to an alternate destination depends on the cost of each individual transmission, and the amount of data that needs to be sent. Cost of individual transmissions is constant for a star topology [1]. To minimize the amount of data to be sent out, we select the set of links that represents the data flow and requires the smallest number of transmissions to an external storage.

2. PROPOSED MODEL

In our work, we are considering two types of failures. *Short failures* are the link failures that can be resolved by the local nodes without transferring any data to the network storage. *Long failures* are the failures that local nodes cannot handle and need to forward the backup data to an alternate destination. Every failure is initially classified as a short failure and the data is stored at sources of the failed links. Once a node runs out of memory, its incoming links are classified as failed and a recovery procedure is initiated at the sources of those links. The process is repeated until the leaf nodes of the network are reached. Due to the nature of the short recovery, the network topology discovery is performed during that step. When nodes involved in the failure can no longer back data up, the failure is reclassified as a long failure. To address the long failure nodes need to collaborate to find the minimum amount of data to be stored at the alternate destination at the smallest communication cost. When considering a flow in a graph, the minimum data set that represents the flow corresponds to the minimum cut of the network flow, which can be computed based on the network topology discovered in the previous step. Once the minimum cut is discovered, only the data of the selected links is forwarded to an alternate destination.

3. REFERENCES

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