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Research Article

An Adaptive Lossless Data Compression Scheme for Wireless Sensor Networks

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Energy is an important consideration in the design and deployment of wireless sensor networks (WSNs) since sensor nodes are typically powered by batteries with limited capacity. Since the communication unit on a wireless sensor node is the major power consumer, data compression is one of possible techniques that can help reduce the amount of data exchanged between wireless sensor nodes resulting in power saving. However, wireless sensor networks possess significant limitations in communication, processing, storage, bandwidth, and power. Thus, any data compression scheme proposed for WSNs must be lightweight. In this paper, we present an adaptive lossless data compression (ALDC) algorithm for wireless sensor networks. Our proposed ALDC scheme performs compression losslessly using multiple code options. Adaptive compression schemes allow compression to dynamically adjust to a changing source. The data sequence to be compressed is partitioned into blocks, and the optimal compression scheme is applied for each block. Using various real-world sensor datasets we demonstrate the merits of our proposed compression algorithm in comparison with other recently proposed lossless compression algorithms for WSNs.

1. Introduction

Wireless sensor networks (WSNs) are suitable for large scale data gathering and they have become so increasingly important for enabling continuous monitoring in many fields. WSNs have find application in areas such as environmental monitoring, industrial monitoring, health and wellness monitoring, seismic and structural monitoring, inventory location monitoring, surveillance, power monitoring, factory and process automation, object tracking, precision agriculture, disaster management, and equipment diagnostics [1–5].

Sensor nodes in WSNs are generally self-organized and they communicate with each other wirelessly to perform a common task. The nodes are deployed in large number and scattered randomly in an ad-hoc manner in the sensor field. Each node is equipped with battery, wireless transceiver, microprocessors, sensors, and memory. Once deployed, the sensor nodes form a network through short-range wireless communication. Data collected by each sensor node is transferred wirelessly to the sink either directly or through multihop communication.

Technological advances in microelectromechanical systems (MEMS) in the recent past have lead to the production of very small size sensor nodes. The tiny size has placed serious resource limitations on the nodes ranging from a finite power supply, limited bandwidth for communication, limited processing speed, to limited memory and storage space. Besides the size, other stringent sensor node constraints include but are not limited to the following: extremely low power consumption; ability to operate in high density; must be cheap (low production cost) and be