Wireless Sensor Networks

Antonio G. Ruzzelli
University College Dublin, Ireland

Richard Tynan
University College Dublin, Ireland

Michael J. O'Grady
University College Dublin, Ireland

Gregory M. P. O'Hare
University College Dublin, Ireland

INTRODUCTION

The origins of networks of sensors can be traced back to the 1980s when DARPA initiated the distributed sensor networks program. However, recent advances in microprocessor fabrication have led to a dramatic reduction in both the physical size and power consumption of such devices. Battery and sensing technology, as well as communications hardware, have also followed a similar miniaturization trend. The aggregation of these advances has led to the development of networked, millimeter-scale sensing devices capable of complex processing tasks. Collectively these form a wireless sensor network (WSN), thus heralding a new era of ubiquitous sensing technology and applications. Large-scale deployments of these networks have been used in many diverse fields such as wildlife habitat monitoring (Mainwaring, Polastre, Szewczyk, Culler, & Anderson, 2003), traffic monitoring (Coleri, Cheung, & Varaiya,, 2004), and lighting control (Sandhu, Agogino, & Agogino, 2004).

A number of commercial WSN platforms have been launched in recent years. Examples include the Mica family (Hill, 2003), Smart-Mesh (http://www.dust-inc.com), Ember (http://www.ember.com), iBeans (Rhee, Seetharam, Liu, & Wang, 2003), Soapbox from VTT (http://www.vtt.fi/ele/research/tel/projects/soapbox.html), Smart-Its (http://www.smart-its.org), and the Cube sensor platform (O’Flynn et al., 2005). As the miniaturization of the constituent components of a WSN continues unabated, power consumption likewise diminishes, thus the current generation of sensors can function perfectly for years using standard AA batteries (Polastre, Hill, & Culler, 2004). Alternative solutions may not require any batteries; for example iBeans (Rhee et al., 2003) coupled with an energy harvester can operate by scavenging energy from tiny vibrations that occur naturally. Miniaturized solar panels are another possible solution for outdoor operation. Production costs of single nodes are estimated to be less than a dollar, a significant cost reduction over the price of older sensor models, thus paving the way for large-scale WSN deployments, possibly consisting of a number of nodes several orders of magnitude greater than that in ad-hoc networks (Akyildiz, Su, Sankarasubramaniam, & Cayirci, 2002).

BACKGROUND

The main components of a WSN are gateways and sensor nodes. The sensor nodes can relay their sensed data either directly to the gateway or through each other depending on the scale of the network. In turn the gateway can send commands down to the nodes to, for example, increase their sampling frequency. In some networks, when the gateway is tethered to an adequate power supply, a greater transmission range can be achieved. This gives rise to an asymmetry in the data acquisition and control protocols, where control commands are sent directly to the node but the data sent from the node to the gateway is multi-hopped. Of course multi hopping of the control commands from the gateway can be used also.

Multi-hopping, while useful in extending the reach or scale of a WSN and reducing the overall transmission cost with respect to direct communication, does have its limitations. The cost of transmitting a packet can be greatly increased depending on the distance a node is from its gateway. Secondly, since nodes nearest the base station, that is, one hop away, will not only have to send their data but also that of all other nodes greater than a single hop, there will be a greater demand placed on the power supply of these nodes. This means that, in general, a node lifespan is inversely proportional to the number of hops it is away from the base station. To alleviate this problem, multiple gateways can be used, with the nodes only transmitting data to their local station. A second solution creates a hierarchy of nodes with varying power and transmission capabilities. Higher power
3 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the product's webpage:

www.igi-global.com/chapter/wireless-sensor-networks/17215?camid=4v1


www.igi-global.com/e-resources/library-recommendation/?id=1

Related Content

Threshold-Based Location-Aware Access Control

www.igi-global.com/article/threshold-based-location-aware-access/55889?camid=4v1a

Adoption of Mobile Technology in the Supply Chain: An Exploratory Cross-Case Analysis

www.igi-global.com/chapter/adoption-mobile-technology-supply-chain/26601?camid=4v1a

Autonomic Cooperative Communications
Michal Wodczak (2019). *Advanced Methodologies and Technologies in Network Architecture, Mobile Computing, and Data Analytics* (pp. 1173-1182).

www.igi-global.com/chapter/autonomic-cooperative-communications/214691?camid=4v1a

Reducing Power and Energy Overhead in Instruction Prefetching for Embedded Processor Systems

www.igi-global.com/article/reducing-power-energy-overhead-instruction/59872?camid=4v1a