Abstract

Wireless sensor networks (WSNs) offer the promise of environmental or industrial system monitoring with minimal infrastructure costs. Potential applications of WSNs may include a safety-critical system in a factory in which sensor data must be reported to a control station that subsequently issues a command to corresponding actuators in a timely fashion. The research described in this report aims to support such control-loop systems through a precise network dimensioning method. The method specifies the worst-case network topology, traffic and node forwarding rates prior to a network deployment and precisely calculates a delay bound for data delivery in a control-loop system. Furthermore, the report details a TDMA-based medium access control (MAC) protocol designed to ensure that the specifications and design assumptions are not violated in a subsequent deployment. The protocol was implemented on TinyOS for the TelosB nodes with a CC2420 radio and was evaluated in a testbed. The evaluation results clearly demonstrated that data were delivered within the delay bound calculated by the network dimensioning method. Hence, the method can precisely determine the maximum data delivery time and support the target WSN applications.