Emerging Applications through Low-Power Wireless Technologies for Internet of Things

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Editorial

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Recently, infrastructure systems such as smart monitoring, smart homes, smart grid, and intelligent transportation, provide services, functionalities, and connectivity that were improbable until a few years ago. This technological progress has happened because the Internet has become increasingly ubiquitous, enabling connection anytime and everywhere not only among people but also among objects widespread in the physical world. The shared vision of such systems is ordinarily correlated with a particular concept: the Internet of Things (IoT). The fast enactment of IoT and the availability of smart devices, with large bandwidths and computational capability, enable real-time service delivery, instant access, and groundbreaking transfer of information. Emerging applications, based on the IoT, enhance the quality of services and the user experience by speeding the request processing and by lessening the data complexity. In this context, smart radio technologies and communication protocols need to be readjusted to emerging IoT application requirements. They should support low-power and ultra-low-power operation, multiple communication ranges in indoor and outdoor environments.

This special collection on 'Emerging Applications through Low-Power Wireless Technologies for Internet of Things' of the *International Journal of Distributed Sensor Networks* (IJDSN) aimed at the collection of high-quality papers that intend to solve open technical problems and typical challenges of emerging IoT applications, to present and integrate novel solutions efficiently, and to highlight the performance evaluation with existing standards.

In the emerging IoT applications, the sensed data should be transferred to the sink in a quick and reliable way. This is guaranteed in the proliferation routing, as the source node makes multiple copies of the data packets and sends them concurrently through multiple paths. However, the proliferation routing scheme does not implement any mechanism of energy savings and traffic adaptability. Instead, Zhang et al.[1] propose a new adaptive green and reliable routing scheme based on fuzzy logic. The essential idea of the scheme introduced by the authors is to vary the number of renewed packet copies according to a fuzzy inference system taking as inputs the residual energy and the distance to the sink. Simulation results reveal that the solution proposed by the authors outperforms the proliferation routing, since it can reduce the maximum energy cost and thus prolong the network lifetime. Remaining on the energy efficiency, a multimode and multi-threshold approach for IoT systems is introduced in Ayadi et al.[2] with the aim of prolonging the lifetime of battery-powered devices. The authors consider the IEEE 802.15.4 standard in the beacon-enabled mode for the wireless personal area network. As the nodes in the network may have different duty cycle with respect to each other, the parameters of IEEE 802.15.4 (i.e. beacon order and superframe order) are tuned and validated dynamically for every group of nodes with similar duty cycle. The obtained results show the best configuration for maximizing energy efficiency.

Sensor networks for infrastructure monitoring need battery-operated sensing nodes with significant lifetime, so energy-savings methods such as receiver-initiated transmission and coordinated sampled listening are exploited. In the approach introduced in Kawamoto et al.,[3] the authors compare both methods regarding power consumption and communication success rate. Their effectiveness requires synchronization among nodes, so a new medium access control (MAC) protocol is proposed, with an additional functionality to rectify the clock drift. The authors validate their solution and estimate that, with the proposed protocol, sensor nodes can operate about 10 years with two 3-V CR123 lithium batteries. Finally, Gao et al.[4] present a vibration-based electromagnetic energy harvesting prototype that produces power to rail-side monitoring equipment and sensors by gathering wheel-rail vibration energy when the train travels. The proposed system involves several parts, such as an electromagnetic energy harvesting component, a lithium battery, and wireless nodes equipped with several sensors. The authors verify their prototype in a real field test scenario, and the obtained results are promising: the sensor nodes of the wireless network can be powered through the electromagnetic energy harvester and lithium battery while they are continuously monitoring the railway track state.

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