

# Preface

To alleviate the energy and spectrum constraints in wireless sensor networks (WSNs), WSNs necessitate energy and spectrum harvesting (ESH) capabilities to scavenge energy from renewable energy sources, and opportunistically access the underutilized licensed spectrum; hence, give rise to the energy and spectrum harvesting sensor networks (ESHSNs). In spite of the energy and spectrum efficiency brought by ESHSNs, their resource management faces new challenges. First, energy harvesting (EH) process is dynamic, which makes balancing energy consumption and energy replenishment challenging. Depleting the sensors battery at a rate slower or faster than the energy replenishment rate leads to either energy underutilization or sensor failure, respectively. Second, the spectrum utilization by sensors in ESHSNs has to adapt to the dynamic activity of primary users (PUs) over licensed spectrum.

In this monograph, we investigate the resource management and allocation, to facilitate energy- and spectrum-efficient sensed data collection in ESHSNs. In Chapter 1, we discuss the motivation to integrate ESH capabilities in WSNs, as well as the network architecture, typical application scenarios, and challenges of ESHSNs. Chapter 2 surveys the related state-of-the-art research literature. In Chapter 3, an EH-powered licensed spectrum sensing scheme is proposed to schedule the spectrum sensors which are dedicatedly deployed for spectrum sensing to periodically estimate the licensed spectrum availability. Accordingly, an access time and power management of battery-powered data sensors is presented as well, which has been verified an effective solution to minimize the energy consumption of data transmission over the available licensed spectrum. In Chapter 4, we propose an online algorithm which jointly manages the available licensed spectrum and harvested energy to optimize the network utility which captures the data collection efficiency of ESHSNs. The proposed algorithm dynamically schedules sensors' data sensing and spectrum access by considering the stochastic nature of EH process, PU activities, and channel conditions. Finally, Chapter 5 concludes the monograph by outlining some open issues, pointing out new research directions for resource management in ESHSNs.

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