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*Editorial*

# Cognitive Radio Enabled Wireless Sensor Networks and Survivability Challenges

**Shamik Sengupta,[1] Walid Saad,[2] and Abhishek Roy[3]**

[1]*Computer Science and Engineering Department, University of Nevada, Reno, NV, USA*
[2]*Department of Electrical and Computer Engineering, Virginia Tech, VA, USA*
[3]*System Design Lab, Network Systems Division, Samsung Electronics, Suwon, Republic of Korea*

Correspondence should be addressed to Shamik Sengupta; ssengupta@unr.edu

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The rapid growth in computation, smart networking, spectrum agile devices, and hardware miniaturization technologies has led to a major revolution in the wireless sensor networking landscape in recent times. In particular, the introduction of wireless sensor nodes (WSNs) with cognition-enabled technologies and dynamic spectrum access capabilities can help improve spectrum utilization and optimize the dynamic bandwidth and quality-of-service (QoS) requirements of application-specific wireless sensor nodes. Cognition-enabled WSNs require research from multidisciplinary fields including understanding physical systems' operation; how systems can be networked in a cognitive and wireless manner; and how they can learn and cooperate with one another. Automated and intelligent management is one of the most critical components in making the next generation smart WSNs more efficient, flexible, resilient, and customizable. Remote monitoring of devices by smart control centers, introduction of smart self-configuration technologies for improvement of WSN performance, and smart coordination of devices are just a few to name that are highly important topics and are therefore attracting significant interest from both academia and industry. There has also been recently a surge in research related to the Internet of Things (IoT) and, more broadly, the integration of sensor networks over emerging wireless technologies. In this respect, the unique combination of the promising wireless paradigm of cognitive radio networks and the use of sensor networks and IoT technologies have opened up new avenues for research and commercialization of such new technologies. The broad diversity of skills required makes this both a challenging and an exciting field of study.

Given these pertinent challenges, this special issue has focused on identifying novel and state-of-the-art solutions to problems related to *cognitive WSNs and their survivability*. The goal of this special issue has been to bring together researchers and practitioners from academia, industry, and government agencies to focus on understanding modern WSN challenges, design challenges and architectures, and establishing original contributions and new collaborations in these areas.

The six articles selected to be part of this special issue address recent research issues/advances shedding light on different aspects related to the design of effective cognitive radio enabled wireless sensor networks.

The article "Design of Interference-Resilient Medium Access for High Throughput WLANs" by L. Reggiani et al. provides a comprehensive overview of the challenges of and solutions to the problem of coexistence between heterogeneous devices operating within the same frequency bands. The authors outline a protocol strategy that forms a control layer for managing the medium access and scheduling resources in order to limit collisions and optimize the WLAN data traffic; this control layer is based on a low-power wide-band technology characterized by interference robustness, like CDMA (code-division multiple access) or UWB (ultra-wideband) for sensors.

In the article "Exploiting Multiple Channels for Low Latency and Semireliable Broadcasting in Cognitive Wireless Sensor Networks," by T.-S. Kim et al., the authors focus on the design of channel assignment mechanisms in cognitive radio enabled networks that perform dynamic channel configuration for utilizing multiple channels. For efficient and semireliable broadcast in cognitive radio WSNs, the authors develop a centralized Channel Assignment Algorithm for a Collision-Reduced Broadcast Tree (CA-CBT) in WSNs.

The article "MAC Protocol for Quality-Aware Real-Time Voice Delivery in Cognitive Radio-Enabled WSNs" by B. Kim et al. provides a quality-aware media access control (MAC) protocol for real-time voice delivery in cognitive radio (CR) enabled wireless sensor networks (WSNs). The authors develop an analytical model for secondary users (SUs) for the Call Admission Control (CAC) of voice traffic using the quality-of-service (QoS) requirements of delay bound and delay bound violation probability.

The article "Heterogeneous Cognitive Radio Sensor Networks for Smart Grid: Markov Analysis and Applications" by L. Luo et al. demonstrates a comprehensive overview of the challenges of and solutions for cognitive radio sensor networks (CRSN) with heterogeneous applications in smart grid. The authors present a novel queuing model which incorporates service rate and functional heterogeneity on the servers and implement preemptive priority among the varying service classes. The work provides a continuous-time Markov chain for performance analysis of CRSN for cognitive systems with various priority classes and bandwidth requirements.

In their article "Energy Efficiency Oriented Access Point Selection for Cognitive Sensors in Internet of Things," C. Ju and Q. Shao consider the problem of energy efficiency for cognitive sensors from a distributed point of view. This research work studies the distributed energy efficient access point (AP) selection for cognitive sensors in the Internet of Things (IoT) by using game theory and distributed learning algorithm.

The article "Cooperative Sequential Sensing of Radio Transmissions in 5G with Improved Cost-Delay Tradeoff" by X. Qiao et al. overviews the feasibility of the cooperative sensing in 5G heterogeneous wireless networks with a centralized control module. By formulating this cooperative sensing problem as a sequential binary hypothesis test problem, the authors demonstrate that the number of unnecessary data samples and the associated cost can be substantially reduced, with guaranteed detection precision.

The Guest Editors would like to thank the authors of all papers submitted (both those that were accepted and those that, unfortunately, could not be included) for considering the special issue to disseminate their work. They also would like to warmly thank all the reviewers for their difficult and conscientious work and for the time they spent in reviewing. They hope that the readers can use the research results presented in these papers to further enhance their knowledge for research and development in cognitive radio enabled wireless sensor networks.

*Shamik Sengupta*
*Walid Saad*
*Abhishek Roy*