

## GUEST EDITORIAL PREFACE

# Special Issue on National Wireless Research Collaboration Symposium (NWRCS 2014)

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Spectrum management is critical for mobile ages because of limited radio frequencies. Future availability of spectrum for national security endeavors and various applications, such as commercial cellular, electric grid, transportation, medical and advanced manufacturing systems in the nation is at risk. There has been extensive academic and industry research, over the last decade on developing advanced spectrum—using concepts and architectures. However, deployable, dynamic, secure, spectrum sharing technologies that demonstrate spectrum sharing, co-existence trust, security and a viable economic model is still in its infancy. The NWRCS 2014 called for open collaboration between research communities and integrated indoor and outdoor test facilities for performing deployable research and experimentation across various spectral bands and applications. The Symposium was held by the Idaho National

Laboratory in collaboration with Idaho State University. It had brought together leading researchers/developers from the academia, industry and government across the nation to:

- Provide a platform for discussing and identifying research that has near-term development and deployment potential.
- Engage researchers with the practical needs of public safety community and introduce the public safety community to developments in wireless communications.
- Assist understanding cutting-edge research solutions for rapid adoption into technology platforms and integration into global standardization efforts.

This issue includes three outstanding papers selected from the Workshop. The last two are regular papers submitted to the Journal. A

brief introduction of each of the five articles is given next.

*Article 1. Secure routing and scheduling in ad-hoc cognitive radio networks for public safety:* This article proposes a flexible and resilient communication system using an ad-hoc cognitive radio network that fully utilizes the available spectrum resources. Two main components of the network are addressed: route discovery and scheduling for these paths. Field-based routing is adopted. The authors also introduce a secure authentication and routing mechanism for this network. A hybrid novel reputation scheme is then proposed to allow for efficient routing in the presence of adversaries. The authors show through simulations that the proposed secure framework can efficiently reduce the transmission delay, be robust to the dynamics of channel availability, and mitigate routing attacks in a cognitive radio network.

*Article 2. Game theoretic study of cooperative spectrum leasing in cognitive radio networks:* In this paper, a novel property-right spectrum leasing solution based on Stackelberg game is proposed for Cognitive Radio Networks, where part of the secondary users present probabilistic dishonest behavior. In this model, the Primary User (PU) as the spectrum owner allows the Secondary User (SU) to access the shared spectrum for a fraction of time in exchange for providing cooperative relaying service by the SU. A reputation-based mechanism is proposed that enables the PU to monitor the cooperative behavior of the SUs and restrict its search space at each time slot to the secondary users that do not present dishonest behavior in the proceeding time slots. The proposed reputation-based solution outperforms the classical Stackelberg games from both primary and reliable secondary users' perspectives. This novel method of filtering out unreliable users increases the PU's expected utility over consecutive time slots and also encourages the SUs to follow the game rule.

*Article 3. Coherent passive backscatter communications using ambient transmitters:* A communications method is presented based on the backscatter modulation of incident radio

frequency signals using low-complexity tags. The incident signals arise from digital television stations used as illuminators of opportunity. A receiver detects the tag using coherent processing algorithms similar to those used in passive radar, extending the detection range over published noncoherent techniques. This method enables shared use of the UHF television band for low-data-rate applications. While analyses suggest that rates exceeding 1 kbps might be achievable at 1 km range, experimental results demonstrate the challenges in designing and implementing such a system.

*Article 4. A piecewise linear time-varying model for modeling the charging and discharging processes of a Lithium-ion battery:* A piecewise linear, time-varying model for modeling the charging and discharging processes of Li-ion batteries is introduced in this paper. Such a model consists of a group of piecewise linear model segments, whose parameters are adapted online over time. Thus, the combined overall model is capable of modeling nonlinear time-varying processes, such as a Li-ion battery charging and discharging processes, quite well. The close matches between actual and model-predicted behaviors demonstrate the effectiveness of the proposed modeling approach and indicate the potential usefulness of such models for a battery management system.

*Article 5. Heuristic based user interface evaluation of mobile money application: a case study:* Mobile money is creating entirely new opportunity for mobile devices and provides functionalities similar to e-commerce. The nature of these devices pose two major limitations that are small screen size and lack of input capability, which makes designing applications for mobile devices a challenging task. This study applied heuristic evaluation to examine the interface of SMS based mobile money application provided by Vodafone called M-Paisa in Fiji. The results show that there are minor usability problems with M-Paisa interfaces and the authors provide their recommendations to address them.

The NWRCS 2014 was a huge success. It included various sessions and panel discus-

sions, and attendees are from everywhere. The Symposium addressed a set of related technologies and concepts that help rapidly transition wireless spectrum-using research to deployable innovations. This special issue consists of the five articles covering important topics of mobile technologies and research including (i) secure routing and scheduling, (ii) cooperative spectrum leasing, (iii) backscatter communications, (iv) modeling the charging and discharging processes of Li-ion batteries, and (v) mobile

money. They are critical, contemporary issues of mobile/handheld computing. The editors thank the reviewers and authors for their great help and contributions. Without them, this special issue would not be possible.

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*Daniel Devasirvatham is an entrepreneurial, innovative and practical wireless engineer, researcher, manager & educator. His contributions extend from Land Mobile Radio and cellular/personal communications, to satellite links and rain radars. He made pioneering contributions to measuring and understanding the radio propagation channels in which these work. He invented and led the development of fast, computationally efficient, low-complexity models and algorithms to economically deploy communications systems, balancing coverage, capacity, and reliability. Using these, he conceived and built a family of RF design tools. He has published papers on RF propagation, coverage design and coverage assessment. He is currently working on Spectrum and Network sharing and Cognitive Radio. In APCO, Daniel is in the Broadband Committee, also in the Standards Development Committee. He was a member of the APCO Homeland Security and Preparedness Committee after 9/11. Daniel was CTO of the DHS/OEC/ICTAP & NTIA/PSIC programs. He was active in First Responder Communications Interoperability, Project 25 Standards, and was the numbering administrator for LTE broadband deployment. He was the technical leader of three Tiger Teams to solve vexing communications problems in sensitive installations in the US and overseas. He has guided new wireless technology research. He takes pleasure in sharing his knowledge through papers, talks and teaching. He holds three patents on predictive communications and a spectrum sharing technique. His interests include disaster recovery communications. He has published, spoken on an FCC panel and chairs a special interest group in the software defined radio forum focused on Deployables in this area.*

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Wen-Chen Hu received a BE, an ME, an MS, and a PhD, all in Computer Science, from Tamkang University, Taiwan, the National Central University, Taiwan, the University of Iowa, Iowa City, and the University of Florida, Gainesville, in 1984, 1986, 1993, and 1998, respectively. He is currently an associate professor in the Department of Computer Science of the University of North Dakota, Grand Forks. He was an assistant professor in the Department of Computer Science and Software Engineering at the Auburn University, Alabama, for years. He is the Editor-in-Chief of the *International Journal of Handheld Computing Research* (IJHCR) and an associate editor of the *Journal of Information Technology Research* (JITR), and has acted as editors and editorial advisory/review board members for over 30 international journals/books and served more than 30 tracks/sessions and program committees for international conferences. He has also won a couple of awards of best papers, best reviewers, and community services. Dr. Hu has been teaching more than 10 years at the US universities and over 10 different computer/IT-related courses, and advising more than 50 graduate students. He has published over 100 articles in refereed journals, conference proceedings, books, and encyclopedias, edited seven books and conference proceedings, and solely authored a book entitled “Internet-enabled handheld devices, computing, and programming: mobile commerce and personal data applications.” His current research interests include handheld/mobile/smartphone/tablet computing, location-based services, web-enabled information system such as search engines and web mining, electronic and mobile commerce systems, and web technologies. He is a member of the IEEE Computer Society and ACM (Association for Computing Machinery).