ADVANCES IN STANDARDS AND TESTBEDS FOR COGNITIVE RADIO NETWORKS: PART I





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Conventional wireless networks have been designed from a centralized perspective and with a predefined infrastructure, such as cellular networks, but this rigid approach lacks flexibility and adaptability, which are advantages of next-generation cognitive radio systems. Thus, it is of paramount importance to design self-configurable cognitive-radio-based networks that are aware of and adaptable to the changing environment to coexist harmoniously with other wireless systems that use a variety of protocols in the same frequency bands. The design of such networks requires the development of a number of new access and transmission technologies to ensure successful coexistence and to avoid causing harmful interference. Cognitive radio technologies such as dynamic spectrum access create huge opportunities for interesting research and development in a wide range of applications including spectrum sensing, navigation, and biomedical/health.

Standards are crucial for the development of new cognitive radio technologies as they encourage innovation in the industry and shorten the time to market of products and technologies. Currently, IEEE 802 and IEEE SCC 41 are developing cognitive-radio-based international standards. Similar standardization efforts are taking place within the European Computer Manufacturers Association (ECMA), European Telecommunications Standards Institute (ETSI), and International Telecommunication Union (ITU).

In addition to the standardization activities, the design and implementation of the corresponding testbed architectures are of equal importance. In particular, it is important to demonstrate not only theoretically, but also practically, that a cognitive radio network can reliably detect a primary user and avoid harmful interference to the primary radio system. It is far from clear, however, what mechanisms and test cases are best suited to implement and test the cognitive radio network with respect to various metrics including the degree of interference prevention, system performance and efficiency, and the cost involved.

In response to the above momentum of interest and popularity, this feature topic aims at providing a timely and concise reference of current research, recent advances, and key technical challenges in the fields of dynamic spectrum access and coexistence, and related areas.

For this feature topic, an overwhelming number of papers were received, and eight papers from a pool of high-quality submissions with positive reviews have finally been selected for publication. The first part of this feature topic, consisting of five articles, are presented in this issue; the remaining three accepted articles will be presented in March 2011. Papers were selected based on their appropriateness for and relevance to this feature topic as well as their technical merits. A number of good papers did not make the cut because of the above-mentioned criteria and the limitation of space. Nevertheless, we want to thank all the authors who submitted their work to this feature topic, and we hope that the many interesting contributions that were not selected will find other venues for publication.

In the following we introduce the five articles by highlighting contributions made therein. We hope our readers will find these articles useful, not only for understanding the recent developments but also for inspiring their own work.

Our feature topic begins with the article "ETSI Reconfigurable Radio Systems — Status and Future Directions on Software Defined Radio and Cognitive Radio Standards," which is contributed by M. Mueck *et al.* This article gives readers an understanding of the current work status of the ETSI Reconfigurable Radio Systems (RRS) Technical Committee, and explains how its work complements IEEE 802 and IEEE SCC 41 activities. Furthermore, the authors have also illustrated a framework of software defined radio and cognitive radio that is elaborated by ETSI RRS for heterogeneous wide-area and short-range system scenarios.

Ko *et al.* next present the article "Channel Management in IEEE 802.22 WRAN Systems," which addresses the importance of considering dynamic channel management in IEEE 802.22 wireless regional area networks (WRANs) — one of the first international standards developed by using cognitive radio techniques and operated in TV white space. In particular, the authors explain the necessity of cognitive radio functionality to effectively protect the incumbent users and dynamically manage the channel allocation in IEEE 802.22 WRANs.

Following an overview on standardization activities, the next three articles focus on the design and implementation of experimental platforms and testbed architectures for cognitive radio networks. First, Chowdhury and Melodia analyze the issues involved in experiments in their article "Platforms and Testbeds for Experimental Evaluation of Cognitive Radio Ad Hoc Networks." In addition to a thorough survey of existing software and hardware tools used for experimental evaluation of cognitive radio ad hoc networks, the authors discuss the challenges involved in integrating various platforms to form multihop networks and the major efforts required for large scale testbed implementations.

The next two articles are case studies of recently developed testbeds, architectures, and prototypes that are crucial for implementation and verification of cognitive radio networks. The first case study was contributed by Newman *et al.* and is titled "Designing and Deploying a Building-Wide Cognitive Radio Network Testbed (CORNET)." Here, the authors present their testbed with the capability of moving beyond the single- or dual-node experimentation that is common in the initial technology phase. In the second article, "Iris: An Architecture for Cognitive Radio Networking Testbeds," Sutton *et al.* describe their software architecture, Iris, for building highly reconfigurable radio networks. In particular, the authors provide an overview of Iris, presenting the unique features of the architecture and illustrating how it can be used to develop a cognitive radio testbed.

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