Preface

During the last few decades, our use of or reliance on the radio spectrum has grown tremendously. Today, we rely on wireless devices and systems to not only enable on-demand, pervasive communications for a large proportion of the population, but also other critical application areas such as scientific and medical research, industrial control and automation, and public safety. As wireless systems and applications continue to proliferate, the demand for precious spectrum resources will continue to grow. For instance, it has been documented that since the release of the latest generation of smart phones, data traffic on some of the cellular networks has increased by over 6,000 %. In the foreseeable future, we expect that the demand for spectrum will continue to increase as new wireless technologies and applications with high data throughput requirements continue to emerge. This insatiable appetite for additional spectrum resources cannot be met by simply allocating new spectrum. The usable capacity of spectrum must be expanded with innovative technologies, regulatory reforms, and removal of market barriers.

Cognitive radio is one of the innovative technologies that has the potential to effectively address the spectrum shortage problem and radically change the way we utilize spectrum. Because of its potential impact, various stakeholders—including regulatory policymakers, wireless device manufacturers, telecommunication operators, and academic researchers—have shown strong interest in it, especially with respect to research and development. Although numerous journal and conference publications, tutorials, and books on cognitive radio have been published in the last few years, the vast majority of them focus on the various physical-layer attributes of the technology. More importantly, these technical publications discuss the cognitive radio in isolation, essentially as a standalone system or network, with little regard for how it may interact with legacy wireless systems or how heterogeneous cognitive radio systems may collaborate with each other. Although this book's main theme is cognitive radio, its specific focus areas are quite different from the existing literature. The primary aim of this book is to provide a comprehensive discussion on how cognitive radio technologies can be employed to enable efficient and harmonious coexistence of homogeneous as well as heterogeneous wireless systems and networks. Because the discussions in the book focus on the problem of coexistence of

wireless systems, most of the book's contents relate to the medium access control layer, rather than the physical layer. In other words, the discussions in this book revolve around how cognitive radio technologies can be used to enable various wireless networks to coexist and efficiently share spectrum.

The intended readership of this book includes wireless communications industry researchers and practitioners as well as researchers in academia. The readership is assumed to have background knowledge in wireless communications and networking, although they may have no in-depth knowledge of cognitive radio technologies. The intention of this book is to introduce communication generalists to the technical challenges of the various coexistence techniques and mechanisms as well as solution approaches which are enabled by cognitive radios.

Below, we provide a brief summary of the contents of each chapter.

- Chapter 1: Introduction. This chapter includes an introduction to a few challenging problems related to the medium access control (MAC) layer protocol design for coexistence of cognitive radio networks.
- Chapter 2: Taxonomy of Coexistence Mechanisms. In this chapter, we discuss the background knowledge on existing coexistence mechanisms in wireless networks, and present a taxonomy that classifies the state-of-art research according to various criteria.
- Chapter 3: Rendezvous of Cognitive Radios. This chapter presents two channel hopping-based rendezvous protocols, for clock synchronous and asynchronous cognitive radio networks, respectively.
- Chapter 4: Coexistence-aware Spectrum Sharing for Homogeneous Cognitive Radio Networks. In this chapter, we present an inter base station (BS) Coexistence-Aware Spectrum Sharing protocol for improving the coexistence of infrastructure-based homogeneous cognitive radio networks.
- Chapter 5: Frequency Reuse Over a Single TV White Space Channel. In this chapter, we study the channel sharing problem where multiple network cells are forced to reuse a single TV white-space channel.
- Chapter 6: Channel Assignment for Multi-hop Cognitive Radio Networks. In this chapter, we propose the segment-based channel assignment algorithm for single radio interface, multi-hop cognitive radio networks.
- Chapter 7: Ecology-inspired Coexistence of Heterogeneous Cognitive Radio Networks. This chapter discusses challenges in heterogeneous coexistence mechanisms and proposes a mediation-based spectrum sharing mechanism for coexistence of heterogeneous wireless systems operating over the white-space.

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