# Guest Editorial
# Cognitive Radio Networks: A Practical Perspective

Contemporary wireless systems must meet increased bandwidth requirements due to the persistent trend for higher multimedia data rates. Increased bandwidth may be achieved by developing efficient strategies for spectrum management. The cognitive radio (CR) concept proposes to push the dynamic spectrum access and efficient resource allocation beyond its traditional limits, by introducing spectrum sharing, coexistence, and cooperation among heterogeneous wireless networks. Although this approach has been worldwide recognized by standardization bodies, challenges and open issues still exist for its implementation in the real world.

The objective of this special issue is to present a collection of high-quality papers reporting latest research advances in the design and implementation of CR networks, as well as survey papers on the major challenges and possible solutions that lead the path to real-world CR systems. The special issue consists of nine articles from 34 submissions worldwide, covering a wide range of topics on architecture design, spectrum access and sensing, geo-location database, coexistence mechanisms, medical applications, prototypes and testbeds.

The first article, "Future of Wireless Communication: RadioApps and related Security and Radio Computer Framework", by Markus Mueck, Seungwon Choi, June Kim, Chiyoung Ahn, Vladimir Ivanov, Gianmarco Baldini, and Antti Piipponen, introduces a framework for the evolution of reconfigurability features in mass-market mobile devices. The solution is compliant with security and spectrum regulations currently under revision in Europe, and paves the way towards a fully-flexible device platform.

A Radio Environment Map (REM) architecture for LTE networks is presented in the second article, "How a Layered REM Architecture Brings Cognition to Today's Mobile Networks", by Jaap van de Beek, Tao Cai, Sebastien Grimoud, Petri Mähönen, Jad Nasreddine, and Janne Riihijärvi. Although REM is a key technology to enable future CR networks, the authors show that it can already be applied to today's commercial networks.

Addressing spectrum scarcity, the third article, "Scenario Making for Assessment of Secondary Spectrum Access", by Young Ju Hwang, Ki Won Sung, Seong-Lyun Kim, and Jens Zander, estimates the amount of spectrum availability for secondary use, and defines a secondary system, its usage, and methods for spectrum sharing.

The status and emerging trends in worldwide regulation of CR networks is presented in "Current Trends in Worldwide Regulation of Secondary Access to TV White Spaces Using Cognitive Radio". There, Maziar Nekovee, Tim Irnich, and Jörgen Karlsson discuss secondary access technologies, including incumbent protection and detection, operation parameters and licensing models in unused TV bands, along with fairness and co-existence issues.

The coexistence of heterogeneous secondary networks in TV bands is addressed in "A Taxonomy of Coexistence Mechanisms for Heterogeneous Cognitive Radio Networks Operating in TV White Spaces". Beside the taxonomy of secondary-secondary co-existence mechanisms, Bo Gao, Jung-Min Park, Yaling Yang, and Sumit Roy discuss technical challenges and shed light on possible solutions.

In the sixth article, "A Cloud Model and Concept Prototype for Cognitive Radio Networks", Sau-Hsuan Wu, Hsi-Lu Chao, Chun-Hsien Ko, Shang-Ru Mo, Chung-Ting Jiang, Tzung-Lin Li, Chung-Chieh Cheng, and Chiau-Feng Liang propose a Cloud Networking model supporting cognitive access to TV white spaces. The authors show that the proposed concept represents a promising technique for establishing new CR models.

In the seventh article, "Testbed for Combination of Local Sensing with Geo-location Database in Real Environments", Jose C. Ribeiro, Rogerio Dionisio, Hugo Esteves, Pedro Duarte, and Paulo Marques propose an experimental testbed and demonstrate how interference from secondary users is mitigated in a test trial scenario. The testbed can sense signals with advanced blind algorithms, update a list of vacant DVB-T channels received from a web-based geo-location database and book available channels.

In the article, "Transforming Healthcare and Medical Telemetry through Cognitive Radio Networks", Rahman Doost-Mohammady and Kaushik R. Chowdhury exploit the CR technology to dynamically use frequencies for healthcare and medical telemetry services. Also, they highlight the main challenges for deploying a practical CR medical-telemetry network.

Finally, when applied to medical Body Area Networks, CR strategies may improve coexistence with other electronic networks. This setting is analyzed in "Cognitive Radio for Medical Body Area Networks Using Ultra Wideband", where Raúl Chávez-Santiago, Keith E. Nolan, Oliver Holland, Luca de Nardis, João M. Ferro, Norberto Barroca, Luís M. Borges, Fernando J. Velez, Vânia Gonçalves, and Ilangko Balasingham show that CR offers viable cost-effective and future-proof solutions, addressing both scalability and coexistence.

In closing, we thank all the authors who submitted their work to this special issue and many experts who participated in the review process. We are very grateful to the former and current Editors-in-Chief, Prof. Michael Fang and Prof. Hsiao-Hwa Chen, for bringing forth this special issue and for their enlightening guidance. This special issue was prepared also with the support of COST Action IC0902 "Cognitive Radio and Networking for Cooperative Coexistence of Heterogeneous Wireless Networks" and of the EC Network of Excellence ACROPOLIS (ICT-257626).

We hope you will enjoy the articles in this collection.

**Biographies**

**Carla-Fabiana Chiasserini** (chiasserini@polito.it) received her Ph.D. in Electronics Engineering and Telecommunications in 2000 from Politecnico di Torino, where she currently is an Associate Professor. She has held visiting positions at the UMASS, at Monash University, and at the University of California at San Diego. Her research interests are in the field of wireless communications and networking; she has published more than 200 papers, among which more than 60 in highly prestigious refereed journals.

**Maria-Gabriella Di Benedetto** (dibenedetto@newyork.ing.uniroma1.it) received her PhD

degree in Telecommunications in 1987 from Sapienza University of Rome, where she currently is a Full Professor. She has held visiting positions at the MIT, the University of California, Berkeley, and the University of Paris XI, France. In 1994, she received the Mac Kay Professorship award from the University of California, Berkeley. Her research interests include wireless communication systems and speech, UWB communications and cognitive networks.

**Ping Zhang** (pzh@bupt.edu.cn) received his Ph.D. degree in Electrical Engineering from Beijing University of Posts and Telecommunications (BUPT) in 1990. He is a professor at the School of Information and Communication Engineering of BUPT. He is an Executive Associate Editor-in-chief on information sciences of Chinese Science Bulletin, reviewer and TPC member of many magazine, journal and conference. His research interests include broadband wireless communication, new technologies on cognitive wireless networks, TD-LTE, MIMO, OFDM and etc.

**Xiangpeng Jing** (jingx@broadcom.com) received his PhD degree in Electrical and Computer Engineering in 2007 from WINLAB, Rutgers University. He has been working in wireless networking since 2001; his research interests include spectrum coordination protocols for unlicensed bands, co-existence of wireless systems, control protocols for cognitive radio networks. Dr. Jing holds 6 U.S. patents and 19 pending patents in wireless multimedia mesh networks. He currently holds a Senior Stuff position at Broadcom Corporation.