SpringerBriefs in Computer Science

Series Editors

For further volumes:
http://www.springer.com/series/10028

Ning Zhang • Jon W. Mark

Security-aware Cooperation in Cognitive Radio Networks

Springer

Ning Zhang
Department of Electrical
and Computer Engineering
University of Waterloo
Waterloo, ON, Canada

Jon W. Mark
Department of Electrical
and Computer Engineering
University of Waterloo
Waterloo, ON, Canada

ISSN 2191-5768
ISBN 978-1-4939-0412-9
DOI 10.1007/978-1-4939-0413-6
Springer New York Heidelberg Dordrecht London

ISSN 2191-5776 (electronic)
ISBN 978-1-4939-0413-6 (eBook)

Library of Congress Control Number: 2013958216

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Cognitive radio networks (CRNs) are envisaged to solve the problem of spectrum scarcity, caused by the current spectrum allocation policy in which only licensed users have channel access rights. In CRNs, unlicensed users are allowed to opportunistically use the idle spectrum bands owned by licensed users to meet the ever-increasing demand on spectrum and increase spectrum efficiency. In order to access the spectrum bands without creating interference to the licensed users, unlicensed users need to conduct spectrum sensing. However, spectrum sensing might be inaccurate due to multipath fading, shadowing, and primary receiver uncertainty. To address this problem, two types of cooperation have been proposed in the literature: cooperative spectrum sensing and cooperative cognitive radio networking (CCRN). For the former, the cooperation is performed among unlicensed users; while for the latter, the cooperation is carried out between unlicensed users and licensed users. As an emerging paradigm, CCRN can achieve mutual benefits for both participants, which will be the focus of this book. Whereas cooperation can also incur security issues, e.g., malicious users might participate in the cooperation to corrupt or disrupt the communication of legitimate users. Those security issues are of great importance and need to be addressed before the widespread deployment of cooperation in CRNs.

In this book, we study cooperative networking in CRNs, where unlicensed users and licensed users cooperate with each other to obtain mutual benefits, taking security aspects into consideration. In Chap. 1, we first give a brief introduction to CRNs, including fundamentals of cognitive radio, spectrum sensing, and cooperation in CRNs. In Chap. 2, a literature survey on cooperative networking in CRNs is provided, followed by a discussion on the security aspects, which also motivate the subsequent works in Chaps. 3 and 4. Specifically, a trust-aware cooperation scheme for CRNs to improve throughput or energy efficiency of licensed users and offer transmission opportunities to unlicensed users, considering the trustworthiness of unlicensed users, is presented in Chap. 3; and a cooperation scheme to enhance secure communications of licensed users is presented in Chap. 4. Numerical results are provided also to evaluate the proposed schemes. Finally, the concluding remarks are given in Chap. 5.

The authors would like to thank Prof. Xuemin (Sherman) Shen, Ning Lu, and Nan Cheng of the Broadband Communications Research Group (BBCR) at the University of Waterloo, and Prof. Rongxing Lu of Nanyang Technological University, for their contributions in the presented research works. Special thanks are also due to the staff at Springer Science+Business Media: Courtney Clark and Jennifer Malat, for their help throughout the publication preparation process.

Thanks also to the first author's parents, Jianguang Zhang and Jianhua Duan, and his wife, Xue Qin, for their love and support.

Waterloo, ON, Canada Ning Zhang
Waterloo, ON, Canada Jon W. Mark

Contents

Acronyms

AF	Amplify-and-forward
BS	Base station
C-B	Cluster-beamforming cooperation scheme
CBSE	Cluster-beamforming scheme for single eavesdropper
CBME	Cluster-beamforming scheme for multiple eavesdroppers
CCRN	Cooperative cognitive radio networking
CR	Cognitive radio
CRNs	Cognitive radio networks
CSI	Channel state information
DF	Decode-and-forward
DSA	Dynamic spectrum access
DSTC	Distributed space-time coding
E-CSI	Eavesdropper's channel state information
FDMA	Frequency-division multiple access
MRC	Maximal ratio combining
NE	Nash equilibrium
PDF	Probability density function
PHY	Physical layer
PU	Primary user
QoS	Quality of service
R-J	Relay-jammer cooperation scheme
SU	Secondary user
SNR	Signal-to-noise ratio
TDMA	Time division multiple access