

https://dspace.org/

Channel assembling and resource allocation in multichannel spectrum sharing wireless networks

Chabalala, Chabalala Stephen

2017

https://hdl.handle.net/10539/24769

Chabalala, Chabalala Stephen (2017) Channel assembling and resource allocation in multichannel spectrum sharing wireless networks, University of the Witwatersrand, <https://hdl.handle.net/10539/24769>

Downloaded from a DSpace repository. https://dspace.org/

UNIVERSITY OF THE WITWATERSRAND

Faculty of Engineering and Build Environment
School of Electrical and Information Engineering

PhD Research

Channel Assembling and Resource Allocation in Multichannel Spectrum Sharing Wireless Networks

by Chabalala Stephen CHABALALA

Supervisors: Prof. Fambirai TAKAWIRA and Prof. Rex van OLST

Abstract

THE continuous evolution of wireless communications technologies has increasingly imposed a burden on the use of radio spectrum. Due to the proliferation of new wireless networks applications and services, the radio spectrum is getting saturated and becoming a limited resource. To a large extend, spectrum scarcity may be a result of deficient spectrum allocation and management policies, rather than of the physical shortage of radio frequencies. The conventional static spectrum allocation has been found to be ineffective, leading to overcrowding and inefficient use. Cognitive radio (CR) has therefore emerged as an enabling technology that facilitates dynamic spectrum access (DSA), with a great potential to address the issue of spectrum scarcity and inefficient use. However, provisioning of reliable and robust communication with seamless operation in cognitive radio networks (CRNs) is a challenging task. The underlying challenges include development of non-intrusive dynamic resource allocation and optimization techniques.

The main focus of this thesis is development of adaptive channel assembling (ChA) and dynamic resource allocation (DRA) schemes, with the aim to maximize performance of secondary user (SU) nodes in CRNs, without degrading performance of primary user (PU) nodes in a primary network (PN). The key objectives are therefore four-fold. Firstly, to optimize ChA and DRA schemes in overlay CRNs. Secondly, to develop analytical models for quantifying performance of ChA schemes over fading channels in overlay CRNs. Thirdly, to extend the overlay ChA schemes into hybrid overlay and underlay architectures, subject to power control and interference mitigation; and finally, to extend the adaptive ChA and DRA schemes for multiuser multichannel access CRNs.

Performance analysis and evaluation of the developed ChA and DRA is presented, mainly through extensive simulations and analytical models. Further, the cross validation has been performed between simulations and analytical results to confirm the accuracy and preciseness of the novel analytical models developed in this thesis. In general, the presented results demonstrate improved performance of SU nodes in terms of capacity, collision probability, outage probability and forced termination probability when employing the adaptive ChA and DRA in CRNs.

Index-Terms—Channel assembling (ChA); cognitive radio networks (CRNs); Dynamic spectrum access (DSA); multiuser multichannel access; radio resource management (RRM).