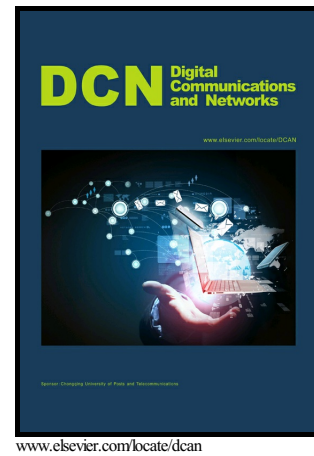


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Optimal resource allocation solutions for heterogeneous cognitive radio networks

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Abstract

Cognitive radio networks (CRN) are currently gaining immense recognition as the most-likely next-generation wireless communication paradigm, because of their enticing promise of mitigating the spectrum scarcity and/or underutilisation challenge. Indisputably, for this promise to ever materialise, CRN must of necessity devise appropriate mechanisms to judiciously allocate their rather scarce or limited resources (spectrum and others) among their numerous users. ‘Resource allocation (RA) in CRN’, which essentially describes mechanisms that can effectively and optimally carry out such allocation, so as to achieve the utmost for the network, has therefore recently become an important research focus. However, in most research works on RA in CRN, a highly significant factor that describes a more realistic and practical consideration of CRN has been ignored (or only partially explored), i.e., the aspect of the heterogeneity of CRN. To address this important aspect, in this paper, RA models that incorporate the most essential concepts of heterogeneity, as applicable to CRN, are developed and the imports of such inclusion in the overall networking are investigated. Furthermore, to fully explore the relevance and implications of the various heterogeneous classifications to the RA formulations, weights are attached to the different classes and their effects on the network performance are studied. In solving the developed complex RA problems for heterogeneous CRN, a solution approach that examines and exploits the structure of the problem in achieving a less-complex reformulation, is extensively employed. This approach, as the results presented show, makes it possible to obtain optimal solutions to the rather difficult RA problems of heterogeneous CRN.

Keywords:

Cognitive radio network, heterogeneous system, linear and non-linear programming, resource allocation.

1. Introduction

It has been recently proposed that cognitive radio networks (CRN), with dynamic spectrum access (DSA) and usage capabilities, can significantly help in mitigating the spectrum scarcity and/or underutilisation challenge [1, 2]. The preliminaries on CRN have been well established, and a fairly comprehensive overview can be found in references [3, 4, 5]. Importantly, from the detailed literature study presented in [6], the authors identified resource allocation (RA) as a key enabler for the realisation of the potentials and

promises of CRN, and therefore, a sizeable amount of work is currently being carried out in this regard. However, there are still a few challenges with RA in CRN that are yet to be extensively addressed, and one such is the necessity of developing and studying RA problems in CRN with the more-realistic consideration of it being a heterogeneous system. In all fairness, introducing heterogeneity into CRN surely portends some intricacies in the RA problem formulations, either with the objectives to be realised or the constraints to be considered. These intricacies associated with such inclusion have made most authors, in their works on RA for CRN, simply ignore or only partially explore the consideration of heterogeneity. Still, because of its significance, it is imperative to study and

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