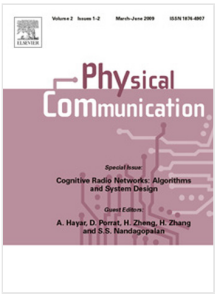

Route selection for interference minimization to primary users in cognitive radio ad hoc networks: A cross layer approach

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Route Selection for Interference Minimization to Primary Users in Cognitive Radio Ad Hoc Networks: A Cross Layer Approach

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***Abstract*—** An opportunistic routing problem in a cognitive radio ad hoc network is investigated with an aim to minimize the interference to primary users (PUs) and under the constraint of a minimum end-to-end data rate for secondary users (SUs). Both amplify-and-forward (AF) and decode-and-forward (DF) relaying techniques are considered for message forwarding by SU nodes in the network. Unlike popular transmit power control based solutions for interference management in cognitive radio networks, we adopt a cross layer approach. The optimization problem is formulated as a joint power control, channel assignment and route selection problem. Next, closed form expression for transmission power is derived and corresponding channel selection scheme and routing metric are designed based on this solution. The proposed route selection schemes are shown to depend not only on gains of the interference channels between SUs and PUs but also on the values of the spectrum sensing parameters at the SU nodes in the network. Two distributed routing schemes are proposed based on our analysis; (i) *optimal_DF* and (ii) *suboptimal_AF*. The routing schemes could be implemented using existing table driven as well as on demand routing protocols. Extensive simulation results are provided to evaluate performance of our proposed schemes in random multihop networks. Results show significant reduction in PUs' average interference experience and impressive performance as opportunistic routing schemes can be achieved by our schemes compared to traditional shortest path based routing schemes. Performance improvement is also reported over prominent recent schemes.

***Keywords*—**cognitive radio ad hoc networks; interference minimization; cross layer approach; distributed routing; QoS.

1. Introduction

One of the key reasons for considering cognitive radio as a promising technique for 5G wireless networks [1] is its potential for dramatically improving spectrum utilization efficiency. In cognitive radio networks (CRNs), two types of users are sharing a common spectrum with different rules: Primary (or licensed) users (PUs) enjoy priority in spectrum access to the bands for which they have licenses, and secondary users (SUs), also known as cognitive users, are allowed to access the same spectrum in a non-invasive manner. Two popular modes of spectrum access exist for SUs; (i) SUs share the same spectrum simultaneously with a PU provided that continuous interference caused to the PU due to SUs' transmissions is within the former's acceptable limit (underlay mode) or (ii) SUs exploit only the unutilized portions of PUs' spectra, popularly referred as *spectrum holes*, in a dynamic manner (opportunistic mode) [2].