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Yue, Wenjing; Zheng, Baoyu; Meng, Qingmin; Yue, Wenjie; Cui, Jingwu

Optimal power allocation for cognitive relay networks: amplify-and-forward versus selection relay.

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Summary: We consider a cognitive relay network which is defined by a source, a destination, and cognitive relay nodes and primary user nodes. In this network, a source is assisted by cognitive relay nodes which allow coexisting with primary user nodes by imposing severe constraints on the transmission power so that they operate below the noise floor of primary user nodes. In this paper, we mainly study the power allocation strategies of this system to minimize the outage probability subject to total and individual power constraints for cognitive relay nodes and subject to interference constraints for primary user nodes. A relay transmission scheme, namely amplify-and-forward (AF), is considered. We first present an optimal power allocation (OPA) scheme to minimize the system outage probability, based on instantaneous channel state information among the source, destination and relay nodes and mean channel gains between primary user nodes and cognitive relays. Next, we propose a selection AF scheme (S-AF) where the single best relay is chosen to assist in the transmission and study power allocation strategy for S-AF to minimize outage probability. The analytical power allocation strategies have been validated through numerical simulations. The results indicate that the AF with OPA and S-AF with OPA have significantly better outage behavior and average throughput than AF and S-AF schemes respectively. We also find that S-AF with OPA achieves a higher throughput, and hence lower outage probability than AF with OPA.

Keywords: cognitive radio (CR); relay networks; power allocation; outage probability
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