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Cooperative spectrum sensing based Distributed Power control Routing Protocol in Cognitive Radio Ad-Hoc Networks

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We investigatecooperative spectrum sensing for awareness of spectrum spatial-temporal correlation characteristics forcognitive radio networking, and the usage for that awareness to facilitate aspects of Cognitive Radio Ad-Hoc Networking (CRAHN), in particular the localised sensing of whether a spectrum band can be opportunistically used for communication, and in achieving greater certainty in routing choices particularly with regard to the QoS characteristics that will be achieved over the local link and the end-to-endCRAHN path. In previous collaborations, cooperative spectrum sensing has beenevaluated by computer simulations taking into account mobility and a detailed modelling of temporal and spatial correlation characteristics of fading and shadowing components in the channel path loss. Simulation results highlight that the incorporation of a chosen metric for correlation in the choice of spectrum sensors leads to a significant decreasein the spatial and temporal update rate required tomaintain acceptable sensing performance,and correspondingly a strong reduction in the overhead caused by the spectrum sensing procedure. Moreover, a Sensing-based Distributed Power Control scheme is proposed to further improve spectrum utilization by exploiting joint spatial-temporal opportunity detection in CRAHNs.

Based on previous achievements, we propose a Distributed Power Control Routing Protocol exploiting mobility-awarenessas well as joint spatial-temporal correlation-based cooperative spectrum sensing to improve routing performance in CRAHNs.Figure 1 simply presents the network topology we designed for routing.In our scenario, we use the shortest distance path selection tochoosethe next hop CR user, and apply a transmission power control scheme to CR users' transmissions, transmission powers being set on the basis of spectrum sensing results. The transmission power utilisedis determined by the maximum interference constrained powerdependent on the distance between the primary user transmitter (or coverage area)and CR users, whereby CR users haveone of three possible power selections: (i) the peak transmission power (i.e., maximum output power) for cases where there is no risk of unacceptable interference to the primary coverage area;(ii) limited transmission power for regions where interference may be caused to the primary coverage area and that interference must be regulated to be below a “interference limit”; (iii) no transmission power for regions where unacceptable interference is highly likely to be caused to the primary coverage area and associated receivers.As implied by this, secondary transmissions areas are divided into three regions corresponding to the allowed transmission power modes. Different transmission powersare implementedfor CR Users in these different areas due to different PU receiver interference tolerate.

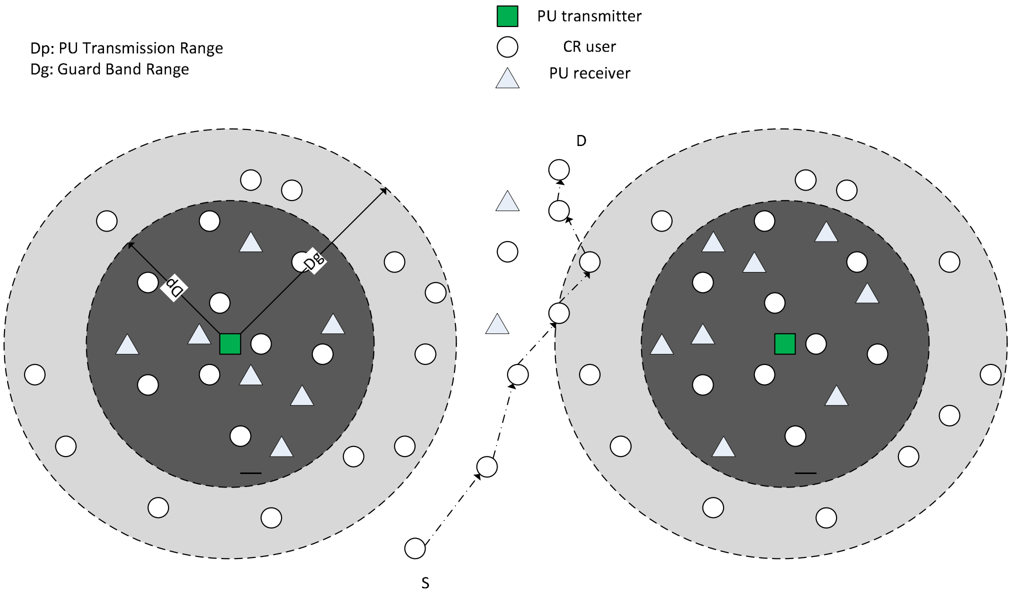

Figure 1

Presented results will be based on computer simulationscarried out usingthe discrete-event simulator Omnet++ (supported by the MiXiM library, which is very useful for the simulation of wireless and mobile networks). Three main aspects are evaluated: (i) cooperative spectrum sensing in CRAHNs in view ofjoint spatial-temporal correlations resulting fromnode mobility; (ii) distributed power control routing by exploiting the sensing results; (iii) evaluationof the routing performance by taking account into characteristics such as end-to-end throughput, end-to-end delay,and the effect onprimary receivers. Regarding the latter, a detailed routing metric is created that takes into account all the above aspects, and is utilized to select the most appropriate end-to-end route for a end-to-end CRAHN communication between secondary nodes, based on the associated traffic requirements and requirements for protection of primary receivers. Moreover, not only does this contribution consider primary protection: it also takes into account secondary-secondary mutual interference in selection of the most appropriate route. Alternative situations are investigated that that consider the route selection based on the interference among secondaries, again with the objective of achieving a desired throughput and delay requirement for the CRAHN end-to-end connection.