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Spectrum Sharing Etiquette Considering Primary User Activity Pattern in Dynamic TVWS via Cournot Game Theory

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Abstract

Television White Space (TVWS) networks only utilizes a licensed channel in the absence of a primary user network (PUN). Therefore, the performance of TVWS networks are greatly depended on activity pattern of PUN. In this paper, we address the problem of spectrum sharing in cognitive radio environment consisting of PUN and TVWS networks from the perspective of spectrum quality. We propose a self-indicating distributive dynamic Cournot spectrum economic game using non-cooperative game. To capture the dynamic parameter that characterizes dynamic TVWS, a differentiating parameter known as the Channel Instability Index (CII), β, was introduced to grade the leased PUN channel holding time (with consideration of the time-varying radio attributes of the dynamic TVWS environment) and to enforce truthfulness in spectrum transactions. Based on the CII model, two possible scenarios were considered. Case I occurs if $\beta = 0$, which signifies stable PUN bandwidth and Case II, occurs if $0.1 \leq \beta \leq 0.9$, which denotes an unstable PUN bandwidth spectrum. Based on our model, it was showed that utility and QoS measured in-terms of probability of dropped packets of TVWS networks were increased by more than 15 % in any epoch with the key enabler as β.

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Author's Contribution

(1) Proposition of a dynamic model to characterize spectrum leasing in the time and frequency domain, thus ensuring fairness in a TVWS environment, (2) development of a novel spectrum demand function in a dynamic spectrum environment, (3) presentation of a novel cost function and utility for heterogeneous networks and (4) comparative evaluation of the models in terms of profit, cost, revenue, and spectrum strategy.

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