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On Dynamic Spectrum Access in Cognitive Radio Networking

Rutabayiro Ngoga Said

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Blekinge Institute of Technology
School of Computing
SE-37179 Karlskrona, Sweden

Handledare:
Professor Adrian Popescu
School of Computing, BTH, Sweden

Biträdande handledare:
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Betygsnämndssuppleant:
Dr. Benny Lövström
School of Engeneering, BTH, Sweden

Abstract

The exploding increase of wireless communications combined with the existing inefficient usage of the licensed spectrum gives a strong impetus to the development and standardization of cognitive radio networking and communications. In this dissertation, a framework for Dynamic Spectrum Access (DSA) is first presented, which is the enabling technology for increasing the spectral efficiency of wireless communications. Based on that, Cognitive Radio (CR) can be developed as an enabling technology for supporting the DSA, which means that the wireless users are provided with enhanced capability for sensing the operating radio environment and for exploiting the network side information obtained from this sensing.

The DSA concept means that the users of a wireless system are divided into a multi-tiered hierarchy with the primary users (PUs) entitled to protection and with cognitive radio capable secondary users (SUs). The improved spectrum efficiency is obtained by means of a medium access control protocol with knowledge about the statistical properties or available local information of the channels already occupied by PUs as well as knowledge about the interference tolerance within which the interference to PUs is kept to a given level. Related to this, emphasis is laid on the protocol capability to determine the efficiency of the secondary sharing of spectrum. Based on the type of available local information, the capacity of opportunistic communication is investigated for three models. These are: with dynamic, distributed channels information; with dynamic, parallel channels information; and under a dynamic sub-channels allocation scheme.

The results indicate that this capacity is robust with reference to the uncertainty associated with localized sensing of distributed dynamic channels and with timely sensing of parallel dynamic channels. The extension to dynamic parallel sub-channels enables resource allocation to be carried out in sub-channels. The analytical results on the performance of sub-channel allocation indicate a robust traffic capacity in terms of blocking probability, drop-out probability and delay performance as function of PUs traffic loads.

Keywords

Cognitive Radio, Cognitive Radio Networking, Dynamic Spectrum Access, Wireless Communications