Cognitive Network Interference

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With the emergence of new wireless applications and devices in the last ten years, there has been a drastic increase in the demand for radio spectrum. Cognitive radio techniques for opportunistic spectrum access are a promising solution to efficiently share the spectrum. Radio devices with cognitive capabilities can learn from the environment spatial and temporal utilization status of the radio spectrum and opportunistically exploit underutilized resources if doing so does not cause interference for other systems. Several off-the-shelf products like ZigBee nodes or WiFi access points use rudimentary cognitive radio techniques by implementing the carrier sensing multiple access (CSMA) protocol. More recently, new cognitive radio techniques have been proposed to enable the deployment of small-cell base stations to provide access to the mobile radio network where the primary (macro-cell) network can't provide the service. However, spectrum sharing is challenging since it creates interference from an unknown number of nodes randomly scattered in the network. This article introduces a new statistical model for cognitive network interference (CNI) based on the theory of truncated-stable distributions. The model accounts for sensing procedures, spectrum reuse protocols, and environment-dependent conditions such as path loss, shadowing, and channel fading. This provides an accurate characterization of CNI in realistic environments, making the model very attractive for operators deploying efficient mobile networks (e.g., heterogeneous networks and small cells), industry developing new wireless applications (e.g., internet of things and smart grids), and regulators planning modern spectrum utilization (e.g., cognitive radio and white space technology). This paper is the winner of The IEEE Communications Society William R. Bennett Prize in the Field of Communications Networking, 2012.

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