Cognitive radio networks promise more efficient spectrum utilization by leveraging degrees of freedom and distributing data collection. The actual realization of these promises is challenged by distributed control, and incomplete, uncertain and possibly conflicting knowledge bases. This dissertation considers two problems in bootstrapping, evolving, and managing cognitive radio networks: the problem of link rendezvous and the problem of distributed bandwidth reservation.

Link rendezvous is concerned with how separate radio nodes initially find each other in a spectrum band with many degrees of freedom, and little shared knowledge. To address the first problem, we present our Frequency Parallel Blind Link Rendezvous algorithm. This approach, designed for recent generations of digital front-ends, implicitly shares vague information about spectrum occupancy early in the process, speeding the progress towards a solution. Furthermore, it operates in the frequency domain, facilitating a parallel channel rendezvous. Finally, it operates without a control channel and can rendezvous anywhere in the operating band. We present simulations and analysis on the false alarm rate for both a feature detector and a cross-correlation detector. We compare our results to the conventional frequency hopping sequence rendezvous techniques.

Distributed bandwidth reservation is concerned about the way in which the network can allocate bandwidth in different spectrums to customers with specific bandwidth requirements without having a central controller with full knowledge. To address this problem, we propose a solution where the nodes in the network act as autonomous agents and negotiate by exchanging proposals, augmented with arguments. These arguments include information about priority status and the existence of other nodes. The agents independently formulate proposals based upon communication desires, evaluate these proposals based upon capacity constraints, create arguments in response to proposal rejections, and re-evaluate proposals based upon received arguments. We present our negotiation rules, messages, and protocol and demonstrate how they interoperate in a simulation environment. The experimental studies show that the approach finds solutions not otherwise apparent to individual nodes, and achieves superior network throughput, request satisfaction, and total number of connections, compared to our baselines.

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The public is welcome to attend.