Policy Specification and Enforcement For Spectrum-Agile Radios

Grit Denker

SRI International, 333 Ravenswood Ave, Menlo Park, California 94025
Grit.Denker@sri.com

Because of the centralized, static nature of current spectrum allotment policy, wireless communication is confronting two significant problems: spectrum scarcity and deployment delays. Current systems are significantly impacted by the lack of access to unused spectrum, and existing spectrum management procedures are too inflexible to react to dynamic operational needs. The policies are static and policy changes are very labor intensive.

Existing policies assume 100% spectrum use; however, studies have shown that most assigned spectrum is unused most of the time. This motivated the goals of DARPA's neXt Generation (XG) Communications Program, which envisions opportunistic spectrum access. XG provides technologies for automatic, dynamic, and opportunistic access to unused spectrum. This requires that radios sense and opportunistically adapt to local RF environments and application needs.

In addition, radios must act according to regulatory rules. Spectrum use policies are authored in more than 200 countries and are verified by each host nation. Policies are customizable to location, user, time, frequency and many other parameters, and they change over time. The large number of operating dimensions to be considered makes it difficult to find a solution for the optimal use of radio spectrum. In XG this problem is solved by using platform-independent *Policy Controls* to regulate spectrum access in changing regulatory environments.

We developed an expressive and extensible policy language for describing policies that meet the needs of a wide variety of spectrum regulation bodies, including reuse of ontological concepts, and for supporting efficient reasoning. We also implemented a policy-conformance algorithm that checks the compliance of candidate transmissions using efficient, state-of-the-art reasoning technology. The design of the algorithm is independent of, yet easy to integrate into, any radio design, to encourage competitive, best-of-breed XG radio development.

We will report on our experience in designing the Cognitive Radio Language (CoRaL). CoRaL is a declarative language based on a typed version of classical first-order logic. We will also summarize the results of our evaluation of various logical formalisms with respect to their appropriateness for the XG domain. Finally, we will illustrate the main concepts of the XG Policy Reasoner.