



Operations Research Seminar

Dynamic Spectrum Pooling: The Cost of Channel Fragmentation

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15:00-16:00 in GL-115
Refreshment 14:45-15:00 in GL-239

Cognitive and software-defined radio have emerged as enabling technologies for meeting the increased demand on the wireless spectrum. In the application discussed here, a segment of the wireless spectrum is reserved for users that compete dynamically for channel allocation. Reconfigurability is a key property of such users in that their channels may consist of a number of disjoint sub-bands allocated to them dynamically; a channel is not simply a fixed, single, continuous band of frequencies. Exploiting this property leads to new and intriguing fragmentation issues. We study a baseline mathematical model of these issues and arrive at a number of important insights that need to be borne in mind in system design. Each user is characterized by a desired total bandwidth and the duration of a time interval over which it is needed. As users come and go, gaps of available bandwidth develop randomly in both size and position. When allocating bandwidth to a user's channel, the spectrum is searched for gaps in a linear scan; gaps are allocated to the channel until the full requested bandwidth has been provided. Fundamental questions include: Is the number of fragments (sub-bands) into which a user's channel is divided a stable process? Is there a relation between the numbers of users and gaps similar to the 50% rule of dynamic storage allocation? Are there normal limit laws similar to those of other fragmentation problems? Affirmative answers to these and similarly posed questions are observed experimentally; the results are rather surprising at first glance, but plausible derivations are given for each. As time permits, we will mention intriguing open problems dealing with more general assumptions, problems that can be profitably addressed by experimental studies.

Joint work with Shuzo Tarumi and Gil Zussman
