



# The Rince Institute

Researching Innovative Engineering Technologies

Dublin City University, Ireland



## Rince Institute Talk: “The Future of Wireless Resource Management: Bootstrapping and Automated Negotiation in Heterogeneous Networks”

by **Prof. Allen McKenzie**

of Virginia Tech (E.T.S Walton Visiting Prof at Trinity College Dublin)

in the Research & Engineering building, **Room S209**, Tue 22nd Jan 2013, at **10:00**.

**Talk Abstract:** The history of wireless communications can be told through the history of resource management. In this talk, I will describe the ongoing evolution from static to dynamic resource management and the concurrent evolution from homogeneous to heterogeneous networks. From this description, I will draw two themes for the future: (1) a need for a pragmatic, bootstrapped approach to dynamic resource assignment, and (2) a demand for robust approaches to automated negotiation between radio agents.

Along the first theme, I will show how unbounded dynamicism leads to failure; instead, we need pragmatically engineered systems that can bootstrap wireless communications from simple beginnings to complex sharing schemes. In particular, I will describe a proposed channel assignment scheme for cognitive radio networks that balances the need for topology adaptation to maximize flow rate and the need for a stable baseline topology to support network connectivity. We focus on networks in which nodes are equipped with multiple radios or transceivers, each of which can be assigned to a channel. First, we assign channels independently of traffic, to achieve basic network connectivity and support light loads such as control traffic, and, second, we dynamically assign channels to the remaining transceivers in response to traffic demand. We formulate the problem as a two-stage mixed integer linear program (MILP) and show that with this two-stage approach we can achieve performance comparable to a fully dynamic channel assignment scheme while preserving a static, connected topology.

In the second theme, I will then describe the necessity of automated negotiation in future systems, including the relationship between these negotiated dynamics and the bootstrapped approach discussed in the first theme. In particular, I will explain some of the tentative steps that we have taken in this direction, including applications of auction theory and coalition game theory. Finally, I will introduce some potential tools and approaches for future research.

**Allen B. MacKenzie Biography:** Allen B. MacKenzie received his bachelor's degree in Electrical Engineering and Mathematics from Vanderbilt University in 1999. In 2003 he earned his Ph.D. in electrical engineering at Cornell University and joined the faculty of the Bradley Department of Electrical and Computer Engineering at Virginia Tech, where he is now an associate professor. During the 2012-2013 academic year, he is an E.T.S. Walton Visiting Professor at CTVR: The Telecommunications Research Centre at Trinity College Dublin.

Prof. MacKenzie's research focuses on wireless communications systems and networks. His research interests include cognitive radio and cognitive network algorithms, architectures, and protocols and the analysis of such systems and networks using game theory. His past and current research sponsors include the National Science Foundation, Science Foundation Ireland, the US Army, the Defense Advanced Research Projects Agency, and the National Institute of Justice.

Prof. MacKenzie is an associate editor of the IEEE Transactions on Communications and the IEEE Transactions on Mobile Computing. He also serves on the technical program committee of several international conferences in the areas of communications and networking, and is a regular reviewer for journals in these areas. Prof. MacKenzie is a senior member of the IEEE and a member of the ASEE and the ACM. He is the author of more than 50 refereed conference and journal papers and the co-author of the book Game Theory for Wireless Engineers.