

**GCOE Special Lecture Series on****Dynamic Spectrum Access in Cognitive Radio Networks**

Date: 10:00 to 16:00 Monday, 15 November, 2010

Place: Room 204, Research Building No.2,

Electrical, Information, and Physics Engineering

Lecturer: Professor Ekram Hossain, University of manitoba, Canada

[www.ee.umanitoba.ca/~ekram](http://www.ee.umanitoba.ca/~ekram)**Abstract:****10:00 – 12:00****Part I:**

Dynamic spectrum sharing through cognitive radios can significantly enhance the spectrum utilization in a wireless network. Simultaneous sharing of the frequency bands among primary and secondary users (i.e., cognitive radios) is possible by restricting the transmission power of the secondary users so as not to cause any harmful interference to the active primary users. In this talk, practical issues and potential approaches in design and engineering of channel access methods in a cognitive radio network will be described. In particular, two approaches, namely, the interference control approach and the interference avoidance approach will be discussed. With the interference control approach, a spectrum sharing method has to ensure the rate (or SINR) and fairness constraints for secondary users as well as interference constraints for primary users. With the interference avoidance approach, spectrum sensing has to be performed efficiently so that the utilization of spectrum holes can be maximized and also the QoS requirements for the secondary users are met. Issues related to design and engineering of multiuser (single-hop and multihop, single-antenna and multiple-antenna) cognitive radio networks will be discussed.

**14:00 – 16:00****Part II:**

In this part of the talk, a framework for resource allocation (i.e., transmission power and rate allocation and admission control) will be presented for cognitive radios for dynamic spectrum sharing using this interference control paradigm. A code-division-multiple-access (CDMA)-based wireless access scenario will be considered where the cellular users are considered as the primary users. The cognitive radios, which communicate in an ad hoc mode using single-hop transmission, are able to dynamically measure/estimate the interference from primary users at their receiving ends. The solution to the resource allocation problem for cognitive radios will be presented subject to their minimum signal-to-noise-plus-interference ratio (SINR) and transmission rate constraints and interference constraints for primary users. Since tracking channel gains instantaneously for dynamic spectrum allocation may be very difficult in practice, a case will be considered where only mean channel gains averaged over short-term fading are available. Due to the usage of mean channel gains (i.e., perturbation in the channel state information) this results in sub-optimal resource allocation for cognitive radios. To this end, for an ad hoc/distributed dynamic spectrum access scenario, using some results from the stability analysis of optimization problems, perturbation in allocated power and transmission rate to cognitive radios will be analyzed as a function of the number of secondary users.

## **Biography**

Since March 2010, Dr. Hossain is a Professor in the Department of Electrical and Computer Engineering at University of Manitoba, Winnipeg, Canada. He received his Ph.D. in Electrical Engineering from University of Victoria, Canada, in 2000. He was a University of Victoria Fellow and also a recipient of the British Columbia Advanced Systems Institute (ASI) graduate student award. Dr. Hossain is an author/editor for the books *Cooperative Cellular Wireless Networks* (Cambridge University Press, 2011), *Dynamic Spectrum Access and Management in Cognitive Wireless Networks* (Cambridge University Press, 2009), *Heterogeneous Wireless Access Networks* (Springer, 2008, ISBN: 978-0-387-09776-3), *Cognitive Wireless Communication Networks* (Springer, 2007, ISBN: 978-0-387-68830-5), *Wireless Mesh Networks: Architectures and Protocols* (Springer, 2007, ISBN: 978-0-387-68839-8), and *Introduction to Network Simulator NS2* (Springer, 2007, ISBN: 978-0-387-71759-3). Currently Dr. Hossain serves as an *Area Editor* for the *IEEE Transactions on Wireless Communications* (in the area of "Resource Management and Multiple Access"), an *Editor* for the *IEEE Transactions on Mobile Computing*, *IEEE Wireless Communications*, and *IEEE Communications Surveys and Tutorials*. He is a registered Professional Engineer (P.Eng.) in the province of Manitoba.

- Heterogeneous wireless access networks (spectrum/resource management, distributed wireless access, network selection, mobility/handoff management)
- Cognitive wireless networks (dynamic spectrum access, spectrum management, spectrum trading, cognitive MAC protocols, performance modeling, cognitive mesh networks), IEEE 802.22-based systems
- Multimedia over WiFi, WiMAX/OFDMA, LTE networks (dynamic resource management, network optimization)
- MIMO-based wireless ad hoc/sensor/mesh networks (resource allocation, end-to-end performance modeling, analysis and optimization)
- Multi-hop cellular and mobile multihop cooperative/relay networks
- Wireless ITS (inter-vehicle and vehicle-to-infrastructure communications)
- Wireless networking among micro-/nano-devices (eHealth applications)
- Network coding for wireless and mobile computing systems
- Service-oriented wireless/mobile network architectures and protocols
- Economic and game-theory models for wireless/mobile communication networks.