

Tutorial Abstract

Design and Deployment of Cognitive Wireless Network over Software-defined Radio Testbed

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A cognitive radio network (CRN) testbed powered by software defined radios (SDRs) provides a complete tool to implement and evaluate algorithms and protocols designed for configurable wireless networks. There are a number of challenges to develop a CRN testbed, including emulating random spectrum availability (unreliable wireless media and prevailing interferences) and random radio availability (dynamic traffic load, and factors such as radio transmission failures), creating dynamic wireless networks without predetermined topology or spectrum allocation, and establishing reliable communications for applications (such as multimedia) in large-scale wireless networks. In this tutorial, we will discuss how to design and deploy a CRN testbed with the consideration of these challenges and special emphasis on the following properties: scalability, configurability, flexibility, transparency, and high fidelity. The tutorial will first present an overview the state-of-the art SDR platforms and CRN testbeds. Then, we will discuss in detail how to implement CRN functionalities with hardware and software demonstrations by using a CRN emulation testbed with USRP radios forming a multi-hop network and communicating with each other over multiple frequencies. Different CRN tasks, including spectrum sensing, dynamic spectrum access, routing adaptation, and traffic control, will be discussed in GNU Radio implementation environment with USRP radios. We will discuss the basic implementation blocks in GNU Radio. The tutorial will also show how CRN SDR testbed emulates physical channel environment under various fading, delay, loss, and mobility scenarios for cognitive networks using an RF network emulator and simulator tool that can digitally control RF channel effects and impulse response. This tutorial will provide the audience with hand-on experience on SDR and CRN testbeds, and demonstrate a comprehensive approach to design, deploy, test and evaluate CRNs with SDRs.

Author Bios

Dr. **Sohraab Soltani** received his Ph.D. degree in Computer Science from Michigan State University (MSU) in 2009. Due to his outstanding research effort, he has received a prestigious dissertation completion award from MSU. He is a Senior Research Scientist in Intelligent Automation Inc. Dr. Soltani's research interests include wireless cognitive mobile

communications, satellite, ad-hoc and sensor networks, stochastic networking and TCP/IP protocol design. He has extensive knowledge in computer security, computer networking and wireless multimedia communication and has published several papers in competitive conferences and journals in these areas. He has strong hands-on experience on GNU radio USRP testbed implementation. Dr. Soltani has been a PI or Co-PI in several NSF and SBIR projects.

Dr. **Yalin Sagduyu** received his Ph.D. degree in Electrical and Computer Engineering at the University of Maryland. He worked as a postdoctoral fellow at Northwestern University on the DARPA project on Information Theory for Mobile Ad Hoc Networks. Currently, he is a Program Manager at Intelligent Automation Inc. His research expertise is in the areas of design, optimization and analysis of wireless networks, game theory, information theory, network security, and satellite communications. He has been PI for several SBIR/STTR projects (including several with Air Force) on cognitive radio networks, cyber superiority, heterogeneous network management, and network monitoring. He authored more than 60 papers on wireless network architecture, design and analysis (many papers directly on game theory, anti-jam, and cognitive radio). He has been a TPC member of major IEEE and ACM conferences. He co-organized 2013 ACM Mobicom Workshop on Cognitive Radio Architectures for Broadband. He is the track co-chair for MAC and Cross-Layer Design at IEEE 25th Annual International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC), 2014.

Dr. **Yi Shi** received his Ph.D. degree in Computer Engineering from Virginia Tech in 2007. He is currently a Senior Research Scientist in Intelligent Automation Inc. and an Adjunct Assistant Professor in the Bradley Department of Electrical and Computer Engineering at Virginia Tech. His research interests include algorithms, optimization, and game theory for cognitive radio networks, MIMO and cooperative networks, sensor and ad hoc networks, and social networks. Dr. Shi served as PI and co-PI for several SBIR/STTR projects on cognitive radio networks, satellite communications, and social networks, and a NSF project on cooperative communications and network coding. He served as an Editor for IEEE Communications Surveys and Tutorials, a Co-chair for ACM Workshop on Cognitive Radio Architectures for Broadband (CRAB) 2013, a Local Organizing Chair for CROWNCOM 2013, and a TPC member of more than 40 major IEEE and ACM conferences. Dr. Shi authored one book, four book chapters and more than 90 papers on network design and analysis. He was recipient of IEEE INFOCOM 2008 Best Paper Award and recipient of the only IEEE INFOCOM 2011 Best Paper Award Runner-Up. He is a Senior Member of IEEE.

Presenters will be Sohraab Soltani, Yi Shi, and Yalin Sagduyu (in order)

This tutorial is for beginner.