

SYLLABUS

TLEN 5839

COGNITIVE RADIO NETWORKING

Spring 2009

Description

Radios are becoming more flexible as more functional blocks are implemented in software. This enables the radios to adapt to different situations and to communicate using a variety of wireless protocols. This course will first examine the fundamental radio components and how these components are implemented in software. The principles of a software architecture to support the software defined radio (SDR) will also be examined. We will then look at the emerging concept of cognitive radios (CR), which build on the capabilities of SDRs by adding the ability for the radio to intelligently sense and respond to its environment. Policy and cooperation mechanisms that enable CRs to interoperate will be developed. The course will take the form of a seminar rather than a traditional lecture-based course. Students who take this course will be expected to collaborate in active discussions in class and write a research- oriented paper on the topic.

Prerequisites

TLEN 5330 (Data Communications 1) or an equivalent course/background and background in radio/wireless networking.

Professors:

Ken Baker
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Douglas C. Sicker
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Course Homepage

On CULearn

TA

TBD

Office hours and location

Professor Sicker – Monday 1-2 pm or by appointment, ECCR 1B54A
Professor Baker – Monday 11-12 pm or by appointment, ECOT 347

Books:

None. Readings will be selected papers from various journals, conferences and workshops.

Important Material

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. (303-492-8671, www.Colorado.edu/disabilityservices) More info can be found at: www.colorado.edu/disabilityservices

The Chancellor and the President have recently fielded several valid complaints from students and parents regarding the lack of adequate faculty accommodation for some students who have serious religious obligations which may conflict with academic requirements such as scheduled exams.

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Therefore, I encourage students to notify me of anticipated conflicts as early in the semester as possible so that there is adequate time to make necessary arrangements.

The full text of the Boulder campus policy can be read on the web at:

http://www.colorado.edu/policies/fac_relig.html

The University has recently adopted a student Honor Code. Individual faculty members are encouraged to familiarize themselves with its tenets and procedures.

The Honor Code can be found at:

<http://www.colorado.edu/policies/honor.html>

and at <http://www.colorado.edu/academics/honorcode/>

The University of Colorado at Boulder policy on Discrimination and Harassment

(<http://www.colorado.edu/policies/discrimination.html>), the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships applies to all students, staff and faculty.

Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550.

Information about the ODH and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://www.colorado.edu/odh>

Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities.

Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

See policies at <http://www.colorado.edu/policies/classbehavior.html> and at

http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

Grading

10% Participation

30% Presentation lead

30% Presentation support

30% Project

Before each presentation, the presenting group will meet with the professors to discuss the paper and their presentation.

Schedule

Lecture 1: Overview of cognitive radio

Lecture 2: Complete Overview and Guidelines for Technical Paper Evaluation.

Lecture 3: We dissect a paper as a group.

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Lecture 4: Radio and Wireless Fundamentals

Lecture 5: SDR and application to cognitive radio networking

The remainder of the term we will discuss the following papers. Papers will not be assigned until the week prior since this is likely to change. The goal will be to complete 2 papers each week.

PAPERS

Technology

Papers addressing background on radio, including

G. J. Minden, J. B. Evans, L. Searl, D. DePardo, R. Rajbanshi, J. Guffey, Qi Chen, T. Newman, V. R. Petty, F. Weidling, M. Lehnerr, B. Cordill, D. Datla, B. Barker, A. Agah, "Cognitive Radios of Dynamic Spectrum Access - An Agile Radio for Wireless Innovation," IEEE Communications Mag, Vol. 45, No. 5, pp. 113-121, May 2007.

Mirabbasi, S., K. Martin, "Classical and Modern Receiver Architectures," IEEE Communications Mag, Vol. 38, No. 11, pp. 132-139, Nov. 2000.

The following 3 from IEEE Communications 2007

McHenry, M.; Livsics, E.; Nguyen, T.; Majumdar, N. "XG dynamic spectrum access field test results," IEEE Communications Mag, Vol. 45, No. 5, pp. 51-57, May 2007.

Chan, S., "Shared spectrum access for the DoD," IEEE Communications Mag, Vol. 45, No. 5, pp. 58-66, May 2007.

Mishra, S.M.; Brodersen, R.W.; Brink, S.T.; Mahadevappa, R., "Detect and avoid: an ultra-wideband/WiMAX coexistence mechanism," IEEE Communications Mag, Vol. 45, No. 5, pp. 68-75, May 2007.

The following 3 from IEEE Communications 2009

Daniel Willkomm, Technische Universität Berlin, Germany; Sridhar Machiraju, Sprint, USA; Jean Bolot, Sprint, USA; and Adam Wolisz, Technische Universität Berlin, Germany, "Approved Primary Users in Cellular Networks: A Large-scale Measurement Study,"

Preston Marshall (DARPA, US), "Closed Form Analysis of Spectrum Data for Analytic Proof of DSA Operation,"

George Atia, Boston University, Anant Sahai, UC Berkeley, and Venkatesh Saligrama, Boston University, "Approved Spectrum Enforcement and Liability Assignment in Cognitive Radio Systems,"

Possibly the following paper:

Suman Banerjee, Arunesh Mirsha, Vivek Shrivastava, Vladimir Brik, Paramvir Bahl, "Towards an Architecture for Efficient Spectrum Slicing," <citation?>

Topics to added depending on interest and direction:

Sensing, Networking, Reasoning, Security as well as papers on Cyclostationary, Interference Temperature, Group sensing, Biologically inspired algorithms

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Standards

A set of papers will be assembled to cover the following standards:

IEEE 802.22

IEEE 802.11 Y

IEEE 802.11 K

SCC41 overview

Policy/Economics

Brad Bernthal, Timothy X. Brown, Dale N. Hatfield, Douglas C. Sicker, Peter A. Tenhula & Philip J. Weiser, "Trends and Precedents Favoring a Regulatory Embrace of Smart Radio Technologies," IEEE INT'L SYMPOSIUM on New Frontiers in Dynamic Spectrum Access Networks, Dublin, Ireland, Apr. 17-20, 2007.

Peter Tenhula, D. H. Hatfield, "The Potential Value of Decentralized Trunking as Regulatory Precedent for the Introduction of Dynamic Spectrum Access Technology," 2nd IEEE Int. Symp. on New Frontiers in Dynamic Spectrum Access Networks (DySPAN), pp. 597-605, April 2007.

Chapin, J.M.; Lehr, W.H., "Time-limited leases in radio system," IEEE Communications Mag, Vol. 45, No. 6, pp. 76-82, June 2007.

"Software Defined Radio Technology for Public Safety," Approved Document SDRF-06-A-0001-V0.00

Gerald R. Faulhaber, "The Question Of Spectrum: Technology, Management, And Regime Change, <citation?>

R. Paul Margie, Efficiency, Predictability, And The Need For An Improved Interference Standard At The FCC," <citation?>

John Chapin And Douglas C. Sicker, "Safety And Certification For New Radio Technologies," IEEE Communications Mag, Vol. 44, No. 9, pp. 30-31, September 2006.

William Lehr and Nancy Jesuale, "Spectrum Pooling for Next Generation Public Safety Radio Systems," 3rd IEEE Int. Symp. on New Frontiers in Dynamic Spectrum Access Networks (DySPAN), October 2008.

Bazon, Coleman. "Licensed Or Unlicensed: The Economic Considerations In Incremental Spectrum Allocations," 3rd IEEE Int. Symp. on New Frontiers in Dynamic Spectrum Access Networks (DySPAN), October 2008.