

Training and Tutorials

Bring your engineers up to speed on critical aspects of cognitive radio and modern radio engineering with CRT short courses and tutorials tailored to the needs of your organization.

Cognitive Radio

Learn what a cognitive radio is and is not, emerging applications and wireless standards such as 802.11y, 802.16h, and 802.22, regulatory and networking implications and commonly used algorithms such as genetic algorithms, case-based-reasoning, hidden-Markov models, and cyclostationarity analysis.



Learn more at: crtwireless.com/Cognitive_Radio_Tutorial.html

Game Theory and Wireless Networks



Learn why game theory is critical to adaptive and cognitive radio networks; different applications and insights of co-operative and non-cooperative games, how to predict convergence and stability of distributed networks, and techniques to evaluate and improve network performance.

Learn more at www.crtwireless.com/Game_Theory_Tutorial.html

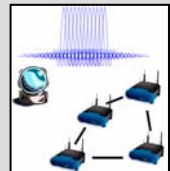
Software Radio

Because of the flexibility, extensibility, maintainability, and numerous new applications enabled, virtually every new radio design is a software radio. Learn SDR design principles including RF design and selection, data conversion, baseband processing techniques, software architectures such as SCA and STRS, and multi-rate techniques.



Learn more at www.crtwireless.com/SDR_Tutorial.html

Emerging Commercial Wireless Standards



Whatever happened to convergence? Now there's WiMAX/ WiBro, 802.22, 802.11a/b/g/h/n/r/s/u/y, TD-SCDMA, Zigbee, WiMedia, WiBree, UMB, LTE, and many more emerging standards to track. In this tutorial, CRT sorts out the 802 alphabet soup and provides an in-depth look at the underlying communications theory (e.g., OFDM/MIMO).

Learn more at: www.crtwireless.com/Wireless_Overview_Tutorial.html



Engineering Design Services
Network and Design Software
Training and Tutorials
Revolutionary Network
Optimization Technology

www.crtwireless.com

Non-Collaborative Distributed Network Optimization

Leveraging our ground-breaking research into game theoretic analysis and design of cognitive radio networks, CRT has developed a suite of distributed non-collaborative algorithms which converge to stable radio resource allocations (e.g., power, frequency, modulation, beam patterns) which optimize network performance without requiring a centralized controller or coordination between distributed controllers.

Highly Scalable

Because our algorithms work with instead of against network interactions, there is no need to:

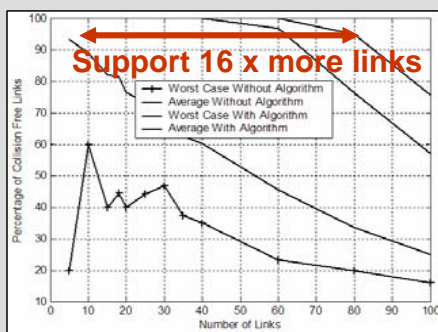
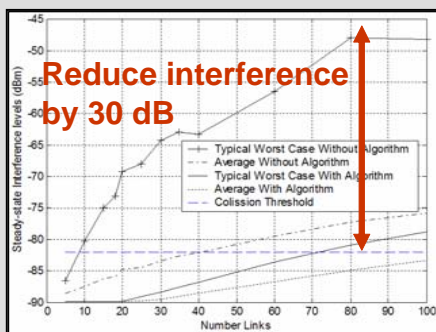
- coordinate adaptations between controllers
- distribute observations between controllers
- message a centralized controller
- distribute clocks

These features enable our algorithms' complexity to scale independently of network size (our basic ad-hoc suite) or scale linearly with network density (our traffic re-active and beamforming suites).

Widely Applicable

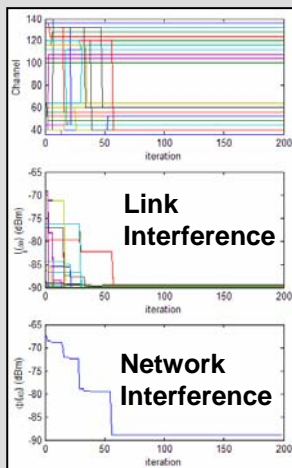
Because our algorithms can address such a broad range of adaptations and scenarios, e.g., channel, power, modulation, transmit/receive beam patterns, MIMO systems, subcarrier allocation, our algorithms can optimize networks running a wide variety of waveforms including: 802.11a/b/g/n, Mobile/Fixed WiMAX, 802.22, LTE, UMB, TD-SCDMA, and Zigbee.

Dramatic Improvements in Network Performance



Learn more at: www.crtwireless.com/technology.html

Transient Behavior



For our algorithms, selfishness is socially optimal

Leverage CRT's long involvement with cognitive and software radio to help your team rapidly design and prototype your cognitive radio solution.

Prototype designs from architecture to implementation

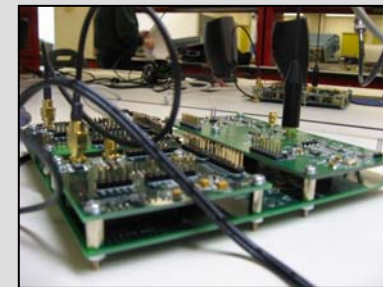
- USRP/GNU, DSP, FPGA, SCA, STRS

Algorithm development

- Traditional waveform processing
- Location services
- Signal classification/detection
- Cognitive networking
- Coexistence and Interoperability

Analysis

- Systems Analysis (SWAP, feasibility analysis)
- MAC/Network behavior
- SDR (SCA, STRS)

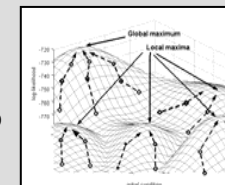


Learn more at: www.crtwireless.com/services.html

Software

Distributed Network Optimizer

Automatically optimize any network's resources post-deployment without sacrificing bandwidth for control messages. Because of our unique non-collaborative design, this software scales to networks of any size and can respond in real-time to changing environmental conditions. Designed to be portable to control any wireless standard, this is the ideal solution for post-deployment optimization of campus and enterprise networks, municipal WiFi networks, femtocells, home gateways, and sensor nets.



Available Fall 08

Systems Design Estimator

Do a week's worth of analysis in five minutes by simplifying your SDR systems design process with our estimator tool. Estimate the cycles power, and memory requirements when porting an existing design or beginning a new design. Identify candidate processing architectures and partitions.

Component	Required Time	Mem	Power	Other	Other	Other	Other	Other
ARM	14	50	0.15	1.8	1.5	650	3.4	700
ARM9	3.2	20	0.04	0.35	0.35	15	0.3	114
CEVA	3.8	44	0.07	0.3	0.48	32	0.5	117
BCM43	8.1	87	0.18	0.5	0.42	218	1.9	434
MIPS24K	1.6	20	0.03	0.25	0.1	14	0.31	65
CM	16	47	0.1	3.35	3.35	360	2.8	488
CSB	21	100	1.6	2.7	1.1	850	5	1128
CSRET	1.24	18	0.02	0.13	0.2	11	0.46	23
CEP	10	67	0.1	1.2	0.7	385	1.8	380
TB200	1.78	20	0.13	0.27	0.4	13.7	1.3	23
ZEP440	8.1	47	0.18	1.8	0.8	326	1.9	420

Available Spring 08

Learn more at: www.crtwireless.com/software.html