James "Jody" Neel, Ph.D.

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VITAE

Section I: Experience and Education

Professional Interests: Research, development, education, and implementation of adaptive networks and cognitive radio

Cognitive Radio	**Implementation**	**Networks**
Cognitive network design	ADC architectures	Wireless standards
Game theoretic analysis	DSP architectures	Radio resource management
Architecture	Multirate signal processing	Ad-hoc networking
Signal detection & classification	Synchronization	MANET routing protocols
Pattern recognition (e.g., data mining, hidden markov models)	Middleware	Adaptive algorithms
Heuristic algorithms (e.g., genetic algorithms)	SCA	Topology formation
Policy design	Software radio	

Education

PhD Virginia Tech Sep 2006	Dissertation: ***Analysis and Design of Cognitive Radio and Distributed Radio Resource Management Algorithms*** Advisor Dr. Jeffrey H. Reed Online: http://scholar.lib.vt.edu/theses/available/etd-12082006-141855/
MSEE Virginia Tech 2002	Thesis: *Implementation and Evaluation of the Layered Radio Architecture* Advisor Dr. Jeffrey H. Reed Online: http://scholar.lib.vt.edu/theses/available/etd-01092003-162405/
BSEE Virginia Tech 1999	

Activities at Cognitive Radio Technologies (2/15/07 to present)

Inferring the intent of Cognitive Radios from Sampled Behavior
Customer: Air Force Research Lab
TPOC: Vasu Chakravarthy, Vasu.Chakravarthy@wpafb.af.mil
Duration: May 2010 – April 2010
Activities: Develop techniques for estimating the goals guiding cognitive radios in networks from samples of their behavior.

SBIR N08-099: Spectrum Planning and Management Capability for Radio Communications
Customer: SPAWAR / JPEO
TPOC: Phase II: Keith Howland keith.howland@navy.mil Vas Kalomiris, Vasilios.kalomiris@navy.mil
Duration: July 9 2008 – Present

Activities: Develop distributed low-overhead embedded algorithms for automating spectrum management Phase I studied this problem in the context of 802.11. Phase II is applying these techniques to WNW.

Cognitive SDR
Customer: Global Electronics
TPOC: Bob Wiebe, bwiebe@geltd.net
Duration: October 2009 – Present
Activities: Design a rapidly deployable system for communicating with and managing the disaster response of assisting first responders in infrastructure-uncertain environments.

SBIR AF-083-160: Cognitive Radio Technology
Customer: Air Force Research Lab
TPOC: Cliff Bullmaster, Clifton.Bullmaster@WPAFB.AF.MIL
Duration: Jan 9 2009 – April 2010
Activities: Develop MAC for compartmentalized cross-layer cognitive network algorithms with support for discontiguous DSA, demonstrate proof-of concept in simulation

Development of a SDR, CR, and Software Controlled Antenna System
Customer: Diversified Technology, Inc.
TPOC: Steve Craven, scraven@dtims.com
Duration: Oct 6 2008 – Present (Phase I, II)
Activities: Support prototyping efforts. Develop cognitive HF waveform.

Trade Study of Implementation of SDR: Fundamental Limitations and Future Prospects
Customer: DARPA (sub through VT, Charles Bostian, PI)
TPOC: Preston Marshall; Preston.Marshall@darpa.mil
Duration: March 11 2008 – Aug 31 2008
Activities: Characterize fundamental limits of ADCs and DSPs and project future performance trends

Software for Estimating Cycle and Power Consumption of Waveforms
Customer: CERDEC (sub through VT, Carl Dietrich, PI)
TPOC: Tim Leissing; Timothy.leising@us.army.mil
Duration: August 2007 – July 2008
Activities: Develop software for estimating the computational resources and power consumption of waveform components across disparate DSP architectures.

Future Wireless Standards and the Emergence of WiMAX
Customer: Syracuse Research Corporation
TPOC: David Bernero; dbernero@syrres.com
Duration: October 3,4, 2007
Activities: Two day tutorial on wireless standards with a focus on WiMAX

A Review of the Proceedings of the SDR Forum Technical Conference
Customer: SDR Forum
TPOC: Al Margulies, asm@sdrforum.org
Duration: 25 May 2007 to 30 September 2007, 19 June 2008 to 30 September 2008
Activities: Review conference papers, identify relevant papers to SDRF communities, identify key emerging technologies, recommend actions for Forum.

Game Theory in the Analysis and Design of Cognitive Radio Networks
Customer: L3-CSW
TPOC: Marc Russon, marc.j.russon@L-3com.com
Duration: April 17-18, 2007
Activities: Two Day Tutorial on Game Theory and Cognitive Radio

Cognitive Radio Tutorial

Customer: GDC4S
TPOC: Sam Khoury, Sam.Khoury@gdc4s.com
Duration: April 9, 2007
Activities: One Day Tutorial on Cognitive Radio with Reed Engineering

Software Radio Technologies Applicable to Naval Communications
Customer: Naval Research Lab / Office of Naval Research
TPOC: Ray Cole, NRL, Ray.Cole@nrl.navy.mil
Duration: April 1 – August 1 2007
Activities: Assess and identify JTRS technologies which would be beneficial to Naval operations.
          Participate in MILES program reviews

Assessment of Wireless Patents
Customer: Alston & Bird
TPOC: Alan L. Whitehurst, 202-756-3491
Duration: April 1, 2007 – July 28, 2008
Activities: Review and provide technical guidance on wireless patents.

Research Activities at Virginia Tech

Assessment of Emerging Wireless Technologies 2006-March 2007 (NRO)

Proposed metrics for evaluating suitability of commercial wireless standards for various data-centric applications including range, latency, throughput, and coverage. Evaluated wireless standards (e.g., 802.11, 802.15, WiMedia, 802.16, GSM, GPRS, EDGE, WCDMA, IS-95, cdma2000, EVDO, EVDO Rev A) according to metrics. Projected suitability of emerging wireless technologies (e.g., UMB, LTE, EDGE Evolution, 802.11n, 802.11p, 802.11y) three and five years into future. Proposed architecture for integrating disparate wireless services and provide real-time adaptation of network in response to changing user demands and priorities.

Application of Game Theory to Wireless Networks 2002-2006 (ONR)

Managed the research of four PhD students and one MS student into the application of game theory to wireless networks. Research focused on creating techniques for establishing steady-states, convergence criteria, and stability for distributed radio resource management algorithms operating at the physical, link, network, and transport layers. Authored the two proposals funding this work. Research publicly available at www.mprg.org/gametheory/

Object-Oriented WLAN Simulator 2001-2002 (Boeing)

Developed integrated OPNET/Matlab simulation for simulating performance of antenna array algorithms in a WLAN and studying cross-layer design techniques.

IS-95 Link Simulation 2001

Coded a simulation of a IS-95 physical layer link in Matlab/C (mex).

Virginia Tech Space Time Advanced Radio (VT-STAR) 2001

VT-STAR is a 2x2 MIMO testbed developed on TI's 6701 EVM boards. Created Matlab performance visualization tool. Optimized radio's DSP code (C/assembly).

Chariot 1999-2000

Chariot was Virginia Tech's primary contribution to GloMo - a multi-university, multi-corporation DARPA funded software radio research program. Responsible for developing simulation/programming interface (Matlab/C++/VHDL) for Stallion – a custom computing machine designed at Virginia Tech and the core processor of Chariot. Also mapped communications algorithms to Stallion processor and contributed to the design of the Chariot controller. Project website: http://mprg.org/research/glomo/index.shtml

Teaching Activities at Virginia Tech

Software Radio, Fall 2006

Co-taught class with three post-doctoral researchers at Virginia Tech. Class follows **Software Radios: A Modern Approach to Radio Engineering**. Instruction responsibilities included processing hardware tradeoffs, multirate processing, data conversion, and cognitive radio.

DSP Implementation of Communications Systems, Spring Semesters 2001, 2002, 2003

DSP Implementation of Communications System has both lab and lecture aspects, covers basic communications algorithms (filtering, signal generation, synchronization, demodulation, equalization), processor architectures, and optimization techniques, and implements these concepts in C and assembly on a TMS320C6701 EVM development board using the Code Composer Studio development environment. Responsibilities included transitioning class material to C67 from C30, developing new labs and lectures on fixed point implementations, code optimization, and rake receivers.

Academic Publications

Textbook chapters

J. Neel. J. Reed, A. MacKenzie, *Cognitive Radio Network Performance Analysis* in **Cognitive Radio Technology**, B. Fette, ed., Elsevier August 2006. (Edition 2: 2009)

W. Tranter, J. Neel, and C. Anderson, *Simulation of Ultra Wideband Communication Systems*, in **An Introduction to Ultra Wideband Communication Systems**, Prentice Hall 2005.

J. Neel and J. Reed. *Case Studies in Software Radio Design*, in Jeffrey H. Reed. **Software Radios: A Modern Approach to Radio Engineering**, Prentice Hall 2002.

J. Reed, J. Neel and S. Sachindar, *Analog to Digital and Digital to Analog Conversion*, in Jeffrey H. Reed, **Software Radios: A Modern Approach to Radio Engineering**, Prentice Hall 2002.

Journal Publications

A. He, K. Bae, T. Newman, J. Gaeddert, K. Kim, R. Menon, L. Morales, J. Neel, Y. Zhao, J. Reed, W. Tranter “A Survey of Artificial Intelligence for Cognitive Radios,” IEEE Transactions on Vehicular Technology Special Issue on Cognitive Radio, February 2010.

Y. Zhao, S. Mao, J. Neel, and J. Reed, "Performance Evaluation of Cognitive Radios: Metrics, Utility Functions and Methodologies," Proceedings of the IEEE vol 97, Issue 4, April 2009.

J. Neel, R. Menon, A. MacKenzie, J. Reed, R. Gilles, "Interference Reducing Networks," submitted to *ACM/Springer MONET Special Issue on Cognitive Radio Oriented Wireless Networks and Wireless Communications*.

J. Neel, P. Robert, J. Reed, D. Jackson, "A formal methodology for estimating the feasible Processor solution space for a software radio", accepted to *Journal of Intelligence Community Research and Development*.

V. Srivastava, J. Neel, A. MacKenzie, J. Hicks, L.A. DaSilva, J.H. Reed and R. Gilles, "Using Game Theory to Analyze Wireless Ad Hoc Networks," *IEEE Communications Surveys and Tutorials* 4th quarter 2005, vol. 7, no 4, pp. 46-54.

Conference Papers

J. Neel, S. Sayed, M. Carrick, C. Dietrich, J. Reed, "PCET: A Tool for Rapidly Estimating Statistics of Waveform Components Implemented on Digital signal Processors," SDR Forum Technical Conference, October 27-30, 2008.

[Best Paper Award] J. Neel, "Synthetic Symmetry in Cognitive Radio Networks," *SDR Forum Technical Conference*, November 5-9, 2007.

S. Won, H. Park, J. Neel, "Inter Cell Interference Co-ordination/Avoidance for Frequency Reuse by Resource Scheduling in OFDM based Cellular System," *VTC Fall 2007*, September 30- October 3, 2007.

J. Neel, R. Menon, A. MacKenzie, J. Reed, R. Gilles, "Interference Reducing Networks," CrownCom07, August 1-3, 2007.

J. Neel, C. Aguayo, J. Reed, "Automated Waveform Partitioning and Optimization for SCA Waveforms," *SDR Forum 2006*, Orlando FL, November 13-17, 2006.

J. Neel, J. Reed, "Performance of Distributed Dynamic Frequency Selection Schemes for Interference Reducing Networks," *Milcom 2006*, Washington DC, October 23-25, 2006.

J. Neel, P. Robert, J. Reed, "A formal methodology for estimating the feasible Processor solution space for a software radio", *SDR Forum Technical Conference 2005*, Orange County, CA, Nov. 14-18, 2005, #1.2-03.

J. Neel, R. Menon, A. MacKenzie, J. Reed, "Using Game Theory to Aid the Design of Physical Layer Cognitive Radio Algorithms," *Conference on Economics, Technology and Policy of Unlicensed Spectrum*, May 16-17 2005, Lansing, Michigan.

J. Hicks, A. MacKenzie, J. Neel, J. Reed, "A Game Theory Perspective on Interference Avoidance," *Globecom 2004*, Nov. 29 – Dec. 3, 2004, vol. 1, pp. 257-261.

[Best Paper Award] J. Neel, J. Reed, R. Gilles, "Game Models for Cognitive Radio Analysis," *SDR Forum 2004 Technical Conference*, Nov. 2004, paper # 01.5-05.

J. Neel, S. Srikanteswara, J. Reed, P. Athanas, "A Comparative Study of the Suitability of a Custom Computing Machine and a VLIW DSP for Use in 3G Applications," *IEEE Workshop on Signal Processing Systems SiPS2004,* Oct 13-15, 2004, pp. 188-193.

J. Neel, J. Reed, and R. Gilles, **"**Convergence of Cognitive Radio Networks," *Wireless Communications and Networking Conference 2004*, March 21-25, 2004, vol. 4, pp. 2250-2255.

J. Neel, P. Robert, A. Hebbar, R. Chembil, J. Reed, S. Srikanteswara, R. Menon, R. Kumar, S. Sayed, **"**Critical Technology Challenges to the Commercialization of Software Radio," *WWRF10 2003*.

S. Ginde, R. Buehrer, and J. Neel, "Game Theoretic Analysis of Joint Link Adaptation and Distributed Power Control in GPRS," *Fall VTC 2003*, vol. 2 pp. 732-736.

[Best Paper Award] J. Neel, J. Reed, R. Gilles, "The Role of Game Theory in the Analysis of Software Radio Networks," *SDR Forum Technical Conference*, San Diego Nov. 11-12, 2002, paper # 04.3-001.

S. Srikanteswara, J. Neel, and J. Reed, "Resource Allocation in Software Radios Using Configurable Computing Machines Based on the SCA," *SDR Forum Technical Conference* November, 2002, paper #06.4-03.

J. Neel, R. Buehrer, J. Reed, and R. Gilles, "Game Theoretic Analysis of a Network of Cognitive Radios," *Midwest Symposium on Circuits and Systems 2002*.

S. Srikanteswara, J. Neel, J. Reed, "Soft Radio Implementations for 3G and Future High Data Rate Systems," *Globecom 2001*, San Antonio TX, no, 1 pp. 3370 – 3374.

S. Srikanteswara, J. Neel, J. Reed, and P. Athanas, "Designing Soft Radios for High Data Rate Systems and Integrated Global Services," *Asilomar Conference on Signals, Systems, and Computers*, Nov. 4-7 2001, vol 1 pp. 51-55.

R. Gozali, R. Mostafa, R.C.Palat, S. Marikar, P.M. Robert, W.G. Newhall, C. Beaudette, S.A. Tsiakkoris, C. Anderson, J. Neel, B.D. Woerner and J.H. Reed, "Virginia-Tech Space-Time Advanced Radio (VT-STAR)," in Proceedings, *Radio and Wireless Conference* (*RAWCON*) *2001*, Boston, MA, pp. 227-231.

Other Publications

J. Neel, et al., "SDR Forum Response to ITU Question ITU-R 241/8: Cognitive radio systems in the land mobile service" Oct 2009, SDRF-08-R-0010-V1.0 Oct 17, 2008.

J. Neel, "Game theory can be used to analyze cognitive radio," *EE Times*, August 29, 2005.

J. Neel, J. Reed, "Wireless, wireless everywhere and now it starts to think," *EE Times*, November 11, 2004.

Selected Conference Presentations

J. Neel, "Issues in Fielding Large Scale Cognitive Radio Networks in Hostile Environments," International Software Radio Conference, June 7-8, 2010.

J. Neel, "Emerging Wireless Standards,",Presented at 18th Virginia Tech Wireless Symposium June 2-4, 2010

J. Neel, "Game Theory in the Analysis of Cognitive Radio Networks," Presented at Wright State University May 12, 2010.

J. Neel, A. Amana , 'An Overview of Cognitive Radio and Intelligent Transportation Systems," SDRF Workshop on Smart Communications in Transportation Systems, June 18, 2009.

J. Neel, "Using the identifying information of Section 15.711(e) to facilitate coexistence of incompatible whitespace protocols," SDRF Workshop on Spectrum Sharing by TV Band Devices, June 16, 2009.

J. Neel, "Emerging Wireless Standards," Presented at 17th Virginia Tech Wireless Symposium June 4-6, 2009.

B. Eydt, E. Good, D. Hatfield, J. Jacob, S. Muir, J. Neel, "Pointing the Finger: How should governments assign liability to promote the success of next generation radio technology," Panel in Regulatory Workshop, SDR Forum Technical Conference 2008, Oct 29, 2008.

J. Neel, "The SDRF Contribution to ITU Question ITU-R 241/8: Cognitive radio systems in the land mobile service," E3-SDRF Joint Workshop, SDR Forum Technical Conference 2008, Oct 27, 2008.

J. Neel, "Analysis of Cognitive Radio Networks," Tutorial, SDR Forum Technical Conference 2008, Oct 26, 2008.

M. Martin, H. Zhao, J. Neel, "Intellectual Property in the Wireless Market: Research, Commercialization and Standards," 17th Virginia Tech Wireless Symposium June 4-6, 2008.

J. Neel, J. Reed, "Emerging Wireless Standards," 17th Virginia Tech Wireless Symposium June 4-6, 2008.

J. Neel, "Networking Cognitive Radios," June 8, 2007, VT Wireless Symposium. Available online: http://crtwireless.com/Symposium_Tutorial.html

J. Neel, "Game Theory in the Analysis and Design of Cognitive Radio Networks," Tutorial at DySPAN 2007, April 17, 2007. Available online: http://crtwireless.com/DySPAN_Tutorial.html

J. Neel, J. Reed, "Game theory implications for cognitive radio design," *SDR Forum Workshop on Cognitive Radio*, San Francisco, April 10, 2006.

J. Reed, J. Neel, "Emerging Commercial Wireless Communication Standards and Their Application to Military Communication Systems," *IDGA Software Radio Summit 2006*, Feb 21, 2006.

J. Reed and J. Neel, "Future of Wireless Networks," July 20, 2005, Monterrey, CA.

J. Reed, J. Neel, L. Morales, "Software Defined Cognitive Radio," *15th Virginia Tech/MPRG Symposium on Wireless Personal Communications* June 8, 2005, MPRG

J. Neel and J. Reed, "Analyzing Cognitive Radio Networks with Game Theory," *7th Workshop on SDR and Smart Antennas*, Hangyang University, Seoul, Korea, May 13, 2005.

R. Gilles, J. Neel, "Using Game Theory to Analyze Wireless Ad-Hoc Networks," Society for Economic Design Meeting, Palma de Mallorca, Spain, June 30 – July 2, 2004.

J. Reed and J. Neel, "Key Challenges in the Design of Software Radios," *IDGA Software Radio Summit 2004* Feb. 23-25, 2004.

J. Neel, "A Short Course in Game Theory and Adaptive Wireless Networks," Virginia Tech, August 2003.

J. Reed, S. Srikanteswara, and J. Neel, "A Short Course on Software Radios," M/A-COM Short Course, May 2003.

J. Reed, S. Srikanteswara, and J. Neel, "Critical Choices for Designing Software Radios," SDR Forum Technical Conference, November, 2002.

J. Reed, S. Srikanteswara, P. Robert, and J. Neel, "Critical Choices for Designing Software Radios," *12th Virginia Tech/MPRG Symposium on Wireless Personal Communications* June 5, 2002.

J. Neel and J. Reed, "A Wireless Integrated Services Environment (WISE) Built Upon A Software Radio Framework," AOL-CIT University Research Day, November 7, 2001.

Successful Authored Proposals at Virginia Tech

"Fractal Radio," ONR, Lead author for technical portion of proposal ~$600,000, Apr 2007-Mar 2010

"Development of a Cognitive Engine", ETRI Invited Proposal, Nov 2005 – Dec 2006. Lead author for technical portion of proposal. ~$200,000 (extendable contract)

"Radio Resource Management for Decentralized Wireless Communications Networks," ONR BAA 02-023 3 Year Basic Research Grant, 2003-2006. ~600,000.

"Software Radios and Smart Antennas: Challenges for Creating Seamless Networks," Samsung Invited Proposal, 2002-2003 ~$500,000. Authored processor design half of proposal.

"Analyzing Interactive Software Radios" Motorola University Partnership in Research Grant, 2002-2004 ~$90,000.

Section III: Other Previous Employment

Employment

Nortel, Jan – Aug 1997, Jan- Aug 1998
> Employed as a co-op in PPM group (returned product repair) in RTP for 2G products. Created various PCS base station component and system test sets, enhanced in hardware / software existing test sets, created S4000 digital pack troubleshooting guides, created / revised S4000 OEM and Digital Pack TSIs, created PPM database tracking software (C++), created software tool for analyzing testing / repair performance statistics (Excel).

Consulting

Reed Consulting, 2006
Assessment of Emerging Wireless Communications Standards
> Surveyed existing and emerging wireless standards – cellular (GSM, IS-95, WCDMA, CDMA2000, 1xEVDO, UMB, LTE, TD-SCDMA, TD-SOFDMA), WPAN (Zigbee, Wibree, Bluetooth, Wireless USB, WiMedia, Z-Wave), WLAN (802.11), WMAN (WiMAX, WiBRO), WAN (802.20, 802.22), and satellite- to assess technologies and trends. Later developed into presentation on applications to electronic warfare presented at CESAS EW Conference Dec. 4, 2006.

SDR Forum, 2004-2007
A Review of the Proceedings of the 2002-2007 SDR Forum Technical Conference
> Annually reviewed the papers from the SDR Forum Technical Conference to identify papers that may provide significant guidance to the SDR Forum, to standards bodies, to the defense community and/or to the commercial sector.

CIA (sub through Mitre), 2005
Processing Hardware Evaluation for SDR
> Developed methodology for estimating processing resources and power consumption for DSPs and FPGA implanting varying wireless standards. Estimated resource consumption for 802.11a and GSM waveforms on Virtex II, Virtex IV, Stratix II FPGA families and 11 families of DSPs (C54, C55, C62, C64, C67, TS203, CEVA, ARM, Blackfin, MSC, ZSP).

Reed Consulting, 2005
Assessment of Emerging Wireless Communications Standards
> Surveyed existing and emerging wireless standards - cellular, WPAN, WLAN, WMAN, WAN, and satellite - to assess technologies and trends. Later developed into presentation on applications of commercial wireless standards to military waveforms at IDGA SDR Summit Feb. 21, 2006.

Syracuse Labs, 2003
A Review of "Data Recovery in Differentially Encoded Quadrature Phase Shift Keying"
> Verified BER performance claims of a novel demodulation scheme through simulation.

Section IV: External Recognition

Patents

J. Neel, "Method and Apparatus for Achieving Bilateral Symmetric Interference for Systems with Multiple Transceivers," US Provisional Patent Application: **61/134,080**, Filing Date: July 3, 2008.

J. Neel, "Method and Apparatus for Achieving Bilateral Symmetric Interference in Asymmetric Wireless Systems," US Provisional Patent Application: **61/130,821**, File Date: May 31, 2008.

J. Neel, J. Reed, R. Gilles, "Low Complexity Distributed Autonomous Dynamic Frequency Selection in 802.11a Networks," US Patent Application: **11/623,428**, File Date: January 17, 2007.

Awards / Recognition/Service

Chair, Cognitive Radio Working Group, SDR Forum, May 2009 – present, co-chair June 2008-May 2009.

Best Paper Award, 2007 SDR Forum Technical Conference (Awarded Oct. 2008)

Best Paper Award, 2004 SDR Forum Technical Conference (Awarded Nov. 2005)

Best Paper Award, 2002 SDR Forum Technical Conference (Awarded Nov. 2004)

Technical Program Committees:
- IEEE Conference on Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM) 2009, 2010
- IEEE Symposium on Dynamic Spectrum Access Networks (DySPAN) 2008- 2010
- IEEE Workshop on Networking Technologies for Software Defined Radio (SDR) Networks 2008
- ICC Cognitive Radio Networks Track 2010
- ISABEL 2008-2010

National Science Foundation Integrated Research and Education in Advanced Networking (IREAN) Fellow, 2003 – 2006, Virginia Tech.

Motorola University Partnership in Research Grant, 2002

Competitive Intercollegiate Trivia (Virginia Tech)
- Captain of Top 15 National Intercollegiate Academic Trivia Team, 2003
- Top Scorer College Bowl Academic Trivia Tournament Region 5, 2002
- Member of Top 5 National Intercollegiate Academic Trivia Team, 1996