Email: deborah.vanvechten@navy.mil
2nd TPOC: Michael Lovellette
Email: Michael.Lovellette@nrl.navy.mil

N151-064 TITLE: Cognitive Radio Architectures for Cyberspace Operations

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: JCREW, FNT 13-03

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the solicitation. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a Cognitive Radio Architecture capability applied to future software-based tactical radio systems giving operators the ability to adapt their communications protocols in near real time.

DESCRIPTION: As general usage of microelectronic devices increases around the world, multiple competing vendors are attempting to capture a market share through the development of proprietary communications protocols designed for specific applications. Today, there are over 20 standard, wireless commercial protocols, but none of them can satisfy every application requirement. The military can no longer afford a different radio for each network it may wish to utilize or pay a high price to adopt an entirely new protocol. This effort seeks to develop an adaptive, next generation software defined radio (SDR) architecture capable of recognizing many standard protocols and variants, as well as the capability to cross-band the information traffic between any pair on the fly. The demonstration of such a design will minimize obsolescence and logistics costs while maximizing interoperability and adaptive functionality.

PHASE I: Define and assess existing spectrum sensing methodologies for an intelligent, agile radio system. Perform an analysis to identify the key strengths and weaknesses of each algorithm. Then, the performer should define and develop an innovative, new algorithm using the REDHAWK Software Communications Architecture (SCA) to monitor, sense, and detect the signal environment and then dynamically reconfigure to adapt to those operating conditions. Also, in considering radio frequency (RF) to internet protocol (IP) based systems, the performer should consider transmission of multiple forms of electronic media in the development of this algorithm. Finally, the performer should use MATLAB, Simulink, or another communication system simulation model to design a SDR system and implement the designed cognitive radio architecture algorithm. The level of fidelity of the simulation model is at the discretion of the performer, but the response to noise and interference inherent in real world environments must be modeled.

At the conclusion of this phase, the performer should provide a focused report on their algorithm with details on the SDRs behavior under different conditions using graphical and quantitative means.

The Phase I effort is unclassified.

PHASE II: Build a prototype model of the SDR system designed in Phase I. Tests should be conducted using commercial-of-the-shelf (COTS) hardware. The performer shall also investigate the usage of System-on-a-Chip (SoC) architectures to enhance the capabilities of the prototype SDR to enable various tactical missions such as electronic warfare, electronic attack, signals intelligence, direction finding/emitter tracking and real-time spectral awareness. Once the prototype is built, tests should be conducted using a wideband, RF channel emulator in a controlled environment. Additional testing at the discretion of the performer shall be conducted in the RF physical environment. Results from these tests will be communicated in an interim progress report to the Principal Investigator (PI) describing the hardware selected and performance in transmit and receive for various forms of digital media.

Following the review of the report and approval by PI, the performer will design and engineer a hand-held tactical system to be used in a relevant operational scenario. This handheld system shall include a visualization capability in order to deploy a spectrum analyzer. Multiple systems should be available for the testing and deployment. This operational test scheduled by the PI will occur during Phase II.

There is a high possibility that the Phase II effort will be classified.

PHASE III: If Phase II is successful, the small business will then work closely with the Naval Air Warfare Center Weapons Division (NAWC-WD) to provide technical guidance and algorithm implementation on tactical radio systems deployed on the Communications Emitting Sensing and Attacking System II (CESAS II) and Intrepid Tiger III (IT3). In addition, share the same algorithms to tactical communication systems under development at Space and Naval Warfare Systems Command Pacific (SSCPAC) PMW-120. The small business will work closely again with NAWC-WD to further develop the handheld device developed in Phase II in order to create a system integrated with CESAS II and IT3.

The science and technology developed in this SBIR will be used on both Navy and Marine Corps tactical systems.

Upon completion of all phases of this SBIR, the small business will create an executable specification of CESAS II, IT3, and the tactical handheld created in Simulink. This will ensure that future tactical communication systems will be able to implement the cognitive radio architecture developed under this SBIR.

There is a high possibility that the Phase III effort will be classified.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The cognitive architecture, tactical handheld system designed during this SBIR could potentially transfer to local, federal and state law enforcement.

REFERENCES:
1. Arslan, H. (2007) Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, New York: Springer.

2. Grayver, E. (2012) Implementing Software Defined Radio, New York: Springer.

3. REDHAWK Manual (8 Nov 2013), redhawksdr.github.io, Retrieved 6 Feb 2014, from http://redhawksdr.github.io/Documentation/

4. W.Y. Yang et al., (2009) MATLAB/Simulink for Digital Communication, Korea: A-JIN Publishing.

KEYWORDS: Open Systems Interconnection (OSI) Model; Spectrum Sensing; Interference; Digital Signal Processing; Path Loss; Multipath Fading

TPOC: Mr. John Moniz
Email: john.moniz@navy.mil
2nd TPOC: Capt Ben Pimentel
Email: benjamin.a.pimentel1@navy.mil

N151-065 TITLE: Innovative Power Electronic Switch for Naval Applications in Extreme Temperatures

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Electronics

ACQUISITION PROGRAM: FNC Power & Energy -FY14-01

OBJECTIVE: Demonstrate an innovative, ultra-power-dense power electronic switch that can operate in ambient thermal variations of -225°C to 150°C for high temperature superconducting (HTS) power systems with 200-300kW