

# Innovation

**SBIR Topic Number:**  
AF083-160

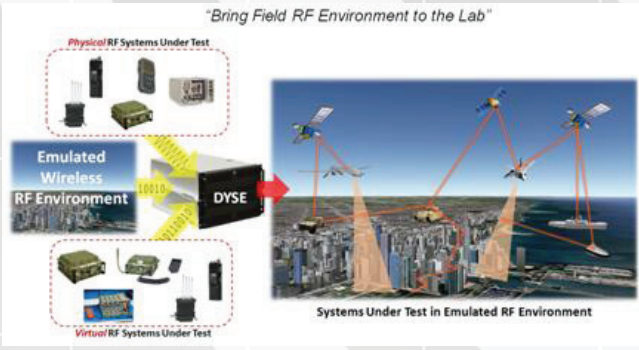
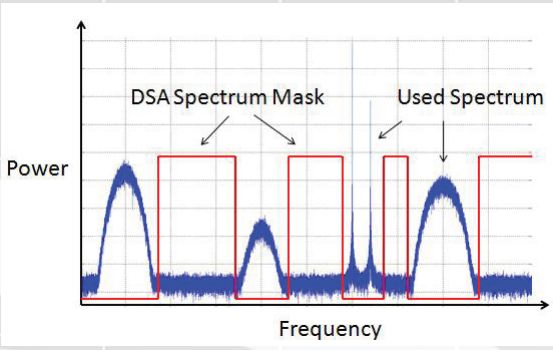
**SBIR Title:**  
Cognitive Radio Technology

**Contract Number:**  
FA8650-10-C-1732

**SBIR Company Name:**  
Shared Spectrum Company, Vienna, VA

**Technical Project Office:**  
AFRL Sensors Directorate, Wright-Patterson AFB, OH

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



**Figure 1: Non-contiguous Dynamic Spectrum Access (DSA) concept. Figure 2: Dynamic Spectrum environment Emulator (DYSE).**

## A Cognitive Radio Technology Solution to the Spectrum Scarcity Problem

- The Air Force is faced with a potential spectrum scarcity problem due to the lack of unlicensed spectrum available to meet the increasing demand for more spectrum by the military, government, and commercial wireless industry.
- Cognitive Radio (CR) technology is a key enabler for a Dynamic Spectrum Access (DSA) solution to the potential spectrum scarcity problem because it enables a radio frequency system to sense and learn the spectrum environment in order to operate in unused portions of licensed spectrum or whitespaces on the condition that no interference is caused to licensed primary users.
- The SBIR technology developed by Shared Spectrum Company and Echo Ridge, LLC builds upon the CR concept and enables a RF system to operate in non-contiguous whitespaces, thus providing a more flexible DSA solution to the spectrum scarcity problem.
- The SBIR technology also provides a field-like Dynamic Spectrum environment Emulator for the RDT&E of DSA technologies.

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## Air Force Requirement

The Air Force is faced with a spectrum scarcity problem due to the lack of unlicensed spectrum available to meet the increasing demand for more spectral bandwidth by the military, government, and commercial wireless industry. To overcome the challenges of a spectrum scarce environment, the Air Force needs a technology that will enable spectrum dependent systems to dynamically access the spectrum required for mission success. This SBIR addresses that need by providing an initial Non-Contiguous (NC) Dynamic Spectrum Access (DSA) capability for communication and radar systems. This SBIR also provides a unique DYNAMIC Spectrum environment Emulator (DYSE) to RDT&E DSA technologies.

## SBIR Technology

Cognitive Radio (CR) technology is a key enabler for a DSA solution to the potential spectrum scarcity problem because it enables a radio frequency system to sense and learn the spectrum in order to operate in the unused portions of licensed spectrum or whitespaces on the condition that no interference is caused to licensed primary users. The SBIR technology developed by Shared Spectrum Company (SSC) and Echo Ridge, LLC (ER) builds upon the CR concept and enables a RF system to operate in NC whitespaces, thus providing a more flexible DSA solution to the spectrum scarcity problem.

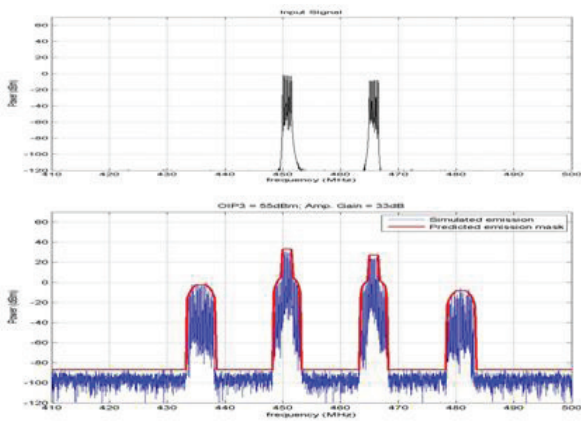


Figure 3: Spectrum Re-Growth Prediction.

Many challenges are associated with enabling communication and radar systems with a NC-DSA capability. In communication systems, one such challenge is spectrum-regrowth. When a NC waveform passes through a non-linear power amplifier, the non-linearity of that power amplifier

generates spectrum re-growth or unwanted spectrum artifacts. If not properly accounted for, spectrum re-growth can cause interference to licensed primary users or fratricide. To address this issue, SSC developed an algorithm to predict spectrum re-growth and generate a NC waveform that minimizes primary user interference. Another challenge in radar systems is the very high sidelobes and thus range ambiguity that results from using NC waveforms. To address this challenge, the company developed an algorithm that synthesizes the NC radar return signal to an equivalent contiguous signal, thus attenuating the high sidelobes.

The firm also built a DYSE to provide a field-like DSA environment to RDT&E DSA technologies. The DYSE is primarily based on COTS components, so it is relatively inexpensive. Furthermore, the DYSE has the capability to interface with physical RF devices in addition to creating its own virtual RF devices to generate almost any DSA environment imaginable.

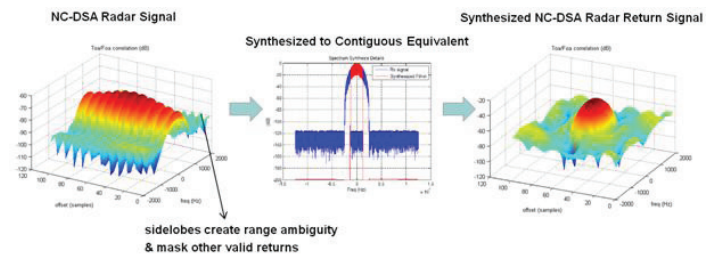


Figure 4: NC-DSA Radar Waveform Synthesis.

## Potential Application

The NC-DSA technology provides the Air Force and commercial wireless industry with a flexible DSA solution for spectrum scarce environments. Furthermore, the DYSE technology provides a field-like DSA emulation environment that can be used by the Air Force and wireless industry to RDT&E DSA technologies.

## Company Impact

“SSC is pleased to have worked with the Air Force Research Laboratory on this important SBIR project,” states Dr. Mark McHenry, SSC president. “The project was well aligned with SSC’s mission of developing pioneering and innovative cognitive radio technologies that eliminate artificial barriers and support more efficient use of spectrum.”

Founded in 2000, SSC is a leading developer of Dynamic Spectrum Access and spectrum management technologies.



# SBIR/STTR

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