Department of the Navy SBIR/STTR Transition Program

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Topic # N192-082

Mobile Phased Array Antenna using Through the Air Link Optical Component (TALOC) Technology

4S - Silversword Software and Services, LLC

WHO

SYSCOM: NAVAIR

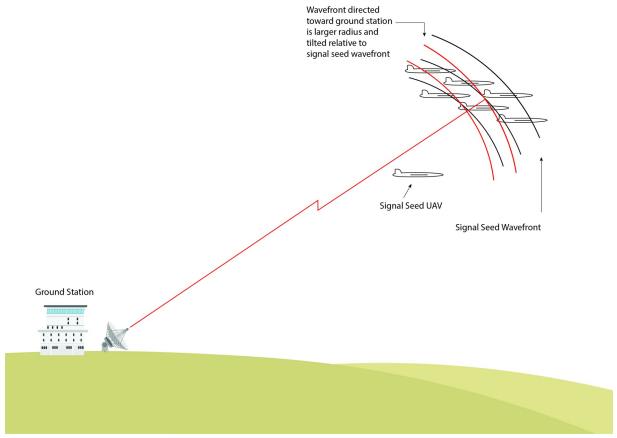
Sponsoring Program: PMA - 265

Transition Target: UAV ensembles including DARPA Gremlins

TPOC:
(301)757-6483

Other transition opportunities: Mobile Deployable Phase Array Radar, Satellite Cluster Adjustable Aperture Phase Array Antenna, Army C5ISR APNT

Notes: The graphic included in this quad chart depicts a mobile phase array antenna formed from an ensemble of UAVs to form a pinpoint communications link between the ensemble and a ground station. The black lines represent a waveform from the command unit to the ensemble. The red waveforms in the direction of the staggered line are directed toward a ground asset. This scanning and defocusing is achieved through calculations based upon the 3D map of the ensemble.



Phase Array Antenna Configuration

WHAT

Operational Need and Improvement: The solicitation requested "State-of-the-art capabilities in optical broadband communications, data fusion software, and mobile platform electro-optical acquisition and tracking to identify an expert system architecture that is near-term realizable and capable of forming an RAS mission group into a mobile phased array antenna. Design a concept for a software development roadmap encompassing expert system formation, autonomous determination of all mission group relative and absolute positions, and formation of a mobile phased array antenna. Determine minimal and optimal number of UASs necessary to form a useful phased array. Assess how an RAS mission group phased array antenna can provide operators with the ability to designate RF links among arbitrary points within the battle space." The technology developed under the Phase I and Phase II efforts addresses the needs and provides secure, mobile, high bandwidth, covert communications links between ensembles of UAVs and ground assets.

Specifications Required: The SBIR solicitation for the Phase II effort listed the following requirements. "Fabricate, test, and demonstrate a phased array antenna residing on a surrogate RAS mission group in a representative environment. Develop an expert system prototype capable of autonomous phased array antenna formation in an environment representative of field conditions such as temperatures of 20 degrees F to 150 degrees F, winds < 40 knots and altitude of 5 – 5,000 feet. Assess potential battle space capabilities and lay out a roadmap for field deployment."

Technology Developed: An optically enabled phase array antenna formed from distributed RF nodes residing on UAVs has been designed and modeled during Phase I and Phase II. This technology enables the accurate 3D mapping of mobile RF nodes for formation of a reconfigurable phase array antenna. The technology utilizes patented TALOC communications capabilities to increase positional accuracies.

Warfighter Value: The TALOC enabled mesh network constitutes an expert system with distributed processors capable of fusing all relative distance and angle measurements into a highly accurate 3D map of the overall mission group. Using the computed 3D map, the mission group is able to organize itself into a mobile phase array antenna and convey to operations center processors the information needed to designate RF links among arbitrary points within a battle space. The phase array antenna can provide operators with full range RF interconnection within the battle space.

WHEN

Contract Number: N68335-21-C-0206 **Ending on:** January 12, 2023

Milestone	Risk Level	Measure of Success	Ending TRL	Date
3D Map formation of antenna nodes	Low	3D Map node configuration	3	November 2017
Relative phase alignment measurement of distributed elements	Med	Required phase measurement achieved	3	September 2018
Successful dynamic element alignment maintenance	Med	Alignment accuracies achieved	4	December 2019
Evaluate beam redirection response to element phase changes	Med	Beam redirection matches theory	4	June 2021
Stage 1 demonstration	Med	Score the degree of success in performing all phase array processes identified in Task 1	5	July 2022
Stage 2 demonstration and TRL assessment	Med	TRL 6 achieved	6	TBD

HOW

Projected Business Model: Our business plan is to license the developed technology to a partner who can take the technology to full production for a program of record. We intend to identify this partner during Phase II. Once identified, we expect to enter into a close working relationship with our partner through all stages of the development.

Company Objectives: 4S - Silversword is seeking Phase 2.5 funding to complete the development and testing required to successfully field the mobile phase array antenna technology developed during Phase I and Phase II. Discussions with potential partners such as Lockheed Martin and Boeing have already been initiated. We intend to bring matching funds from potential partners and programs of record to improve the funding base of the Phase 2.5 SBIR investment..

Potential Commercial Applications: Telecommunications commercial opportunities

Low Earth Orbit (LEO) internet service is notable among emerging telecommunications initiatives. If, instead of a single RF antenna, each satellite links to a cluster of tethered RF nodes, broad band data streams may be bidirectionally directed in parallel to highly localized surface receivers. An early version of phase array narrowcast communications could be deployed in the form of aerostats or drones hovering over urban areas for 5g/6g connectivity.

Terrain mapping commercial opportunities

The potential value added to Side Looking Airborne Radar (SLAR) by phase array lies in the fact that SLAR cross range resolution is inversely proportional to antenna length in the direction of flight. If a phase array antenna is extended hundreds of meters by phase alignment of a linearly deployed swarm, SLAR cross range resolution becomes competitive with LIDAR while across track range is inherently well beyond the capability of LIDAR.

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