OBJECTIVE: Develop an innovative and operationally suitable consolidated (minimized size and weight) antenna solution for sensing and transmitting broadly across the electromagnetic spectrum.

DESCRIPTION: Marine Corps Systems Command (MCSC) provides vehicle-mounted Electronic Warfare Systems (EWS) for geo-locating, direction finding, and countering threats on the ground and in the air. In order for these systems to be maximally effective against the breadth of potential threats, they must be able to sense and defeat a variety of complex threat signals across the electromagnetic spectrum at once.

With the emergence of ultra-wideband photonic receiver technology that can very rapidly process, de-conflict, and identify threats across the entire frequency range of the electromagnetic spectrum, there comes a need for complimentary broadband antenna hardware to sense threats and transmit to defeat them. Current antenna technologies are limited in frequency range and thus multiple antennae are required to cover broad ranges, especially at the lower end of the frequency range.

Requirements for the Broadband Antenna for Photonic Receiver are as follows: Demonstrate a broadband antenna for a photonic receiver in the frequency range from DC to 20GHz (threshold), CD to 80+GHz (objective). This should be achieved with threshold of 4 antennae with a preference that multiple antennae occupy the same physical space. Antennae that occupy the same physical space will be considered one antenna, even if they are electromagnetically multiple antennae. No single antenna should exceed a 1ft cube in size. The total weight for the antennae solution must not exceed 50lbs (threshold) with an objective of 10lbs. As a threshold, the composite antennae solution must both receive and transmit across the entire frequency range. As an objective, it should be able to receive and transmit simultaneously at the same frequency. The antenna must have a ±45° field of view (threshold). Viable solutions must have a flat gain response within each octave of less than 1dB gain (threshold), less than 0.5dB gain (objective). Small regions of non-flatness (up to 3dB off the gain) are acceptable so long as they can be adequately characterized and assumed within the antenna pattern. A preference is provided to a systems with a gain response better than unity (0 dB) over the frequency range. The broadband antenna is intended to be used as part of a vehicle-mounted expeditionary EWS, so it should be water resistant and capable of functioning on the move. The system should be designed to meet MIL STD 810H, but testing of prototypes is not included in the scope of the research. The solution must use standard radio frequency interfaces to easily integrate with PORs and the required frequency interfaces need to be defined in any proposal. A preference is provided to minimizing the number and type of interfaces needed to cover the entire frequency range.

The Phase I effort will not require access to classified information. Work produced in Phase II may become classified. Note: The prospective contractor(s) must be U.S. Owned and Operated with no Foreign Influence as defined by DOD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Security Service (DSS). The selected contractor and/or subcontractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this contract as set forth by DSS and
the Marine Corps in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advance phases of this contract.

PHASE I: Develop concepts for a broadband antenna that can be integrated with a photonic receiver and vehicle-mounted EWS, and that meets the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps needs and establish that the concepts can be developed into a useful product for the Marine Corps. May establish feasibility through modeling and simulation. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction and includes specification for a prototype.

PHASE II: Develop a scaled prototype integrated with representative receiver(s) that cover the frequency range for evaluation purposes in an actual or simulated electromagnetic environment representative of the breadth, volume, and complexity of an operational electromagnetic environment. Evaluate the prototype to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for integration with an electronic warfare system as the front-end antenna. Demonstrate system performance through prototype evaluation and modeling or analytical methods that demonstrate the preprocessing capability with a test case for each of the three objectives listed in the description above. Use evaluation results to refine the prototype into an initial design that will meet Marine Corps requirements. Prepare a Phase III development plan to transition the technology to Marine Corps use. It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL-USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop a ruggedized broadband antenna for integration and evaluation to determine its effectiveness in an operationally relevant environment. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

As the communications industry grows and advances in capability exponentially, antenna technology remains an important enabler to maximize performance while minimizing cost and footprint. The developer of this broadband antenna could potentially market the solutions or products derived lessons learned to the communications industry.

REFERENCES:


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KEYWORDS: Electronic Warfare; Electromagnetic Spectrum; Broadband Antenna; Photonics; Receive and Transmit; Sensing; Flat Gain Response