**SMALL BUSINESS INNOVATION RESEARCH**

**phase ii statement of objectives**

**for**

**Nanosatellite Payloads for Tactical Intelligence, Surveillance, and Reconnaissance**

**TOPIC SOCOM193-D001**

**July 19, 2019**

I. **INTERNATIONAL TRAFFIC AND ARMS REGULATION:** The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation*.*

II. **BACKGROUND**:

USSOCOM is interested in improving its capabilities in intelligence collection, surveillance, and reconnaissance from spaceborne platforms. Although existing national assets and commercial services can provide ISR data to USSOCOM users, USSOCOM desires more abundant capabilities for rapid collection and dissemination of actionable data. A constellation of ISR satellites is envisioned. Since costs (developmental, procurement, and launch) are all generally correlated with spacecraft size, building such a constellation with traditional large spacecraft would be cost-prohibitive. Thus, it is advantageous to reduce the size of the spacecraft as much as possible.

Nanosatellites, and particularly CubeSats, have become increasingly popular in the last decade. Although many of the first missions were academic or experimental in nature, more recent missions have demonstrated the feasibility of using these platforms for actual operational capabilities. Certain missions that would have traditionally been performed by larger spacecraft can be transitioned to these smaller platforms, resulting in numerous benefits.

There are, however, also technical tradeoffs and challenges in hosting payloads on nanosatellites rather than larger platforms. The payload must have a smaller volume and be shaped appropriately. Available power is limited, both instantaneously and orbit-averaged. Thermal regulation, attitude control, onboard processing, and communication data-rates are all typically poorer on smaller spacecraft than their larger counterparts.

The purpose of this SBIR topic is to advance the state-of-the-art of technologies for small satellite ISR data production and delivery, acknowledging both the mentioned challenges and the harsh space environment. The desired outcome is a higher TRL (Technology Readiness Level but not to exceed TRL 7) packaged ISR payloads for nanosatellites. Resulting payloads should demonstrate novel capabilities or significant advantages over spacecraft ISR payloads currently available on this size scale.

In terms of the missions themselves, USSOCOM is interested in ISR data of various forms. Broadly, USSOCOM is interested in detecting, geolocating, identifying, and/or characterizing people and equipment within designated areas of interest. (note that both terrestrial and maritime environments are applicable). Collection methods could include, as one example, analyzing imagery in the visible band (this is already the most prolific and mature of nanosatellite missions). Additional utility might be achieved by expanding imagers into the infrared regime or improving spectral resolution. Other techniques might be able to derive actionable intelligence from RF signals, by either actively probing (e.g. synthetic aperture radar) or passively collecting, enabled by advancements in antennas and software-defined radios. Other methods of remote sensing, such as those used on scientific missions, might offer unexplored utility when applied to USSOCOM ISR applications. These descriptions are non-exhaustive, and suggestions for ISR methods not-listed might also be appealing.

So long as the proposed effort is developmental in nature, there are multiple avenues that could be followed in achieving the desired outcome of producing packaged nanosatellite ISR payloads that advance the state-of-the-art. The following are all within scope of this topic:

* Innovating with novel sensors or designs to produce nanosatellite ISR payloads for which fundamental merits have been demonstrated, but there are no operational heritages.
* Miniaturization of larger ISR payloads to the nanosatellite form factor.
* Repurposing of existing technologies or payloads to meet USSOCOM-specific ISR needs. This could include, for example, development of novel software processing techniques to derive new conclusions from common sensors, or hardware modifications to enhance collection capabilities on USSOCOM-peculiar targets.
* Adaptation of payloads used on ground, sea, or airborne platforms to the nanosatellite platforms. Developments would need to account for the challenges unique to nanosatellite platforms, including reduced SWaP of the new platforms, the challenges of the space environment, and the greatly increased ranges between the sensors and targets.
* Fusion of data between two or more bundled sensors, to enable exploitation of data in ways not possible on prior payloads with singular sensors.

Emphasis is placed upon rapid tactical operation. The envisioned CONOPs would have a user (in the tactical theatre) issuing an ISR request to the constellation, the satellites autonomously performing data collections as necessary, and then quickly downlinking the results back to the user. Although payload developers are not responsible for the communications infrastructure itself, they should be mindful of the quantities of data that their payloads produce, especially since ISR sensors are typically able to produce large quantities of data in excess of downlink capabilities. If possible, mitigation of the downlink requirements is desirable, for example by extracting and downlinking only key conclusions rather than the entirety of the raw data.

USSOCOM does not pose strict requirements for the usage of any particular satellite host bus, but preference is given to selecting a commercial host bus that follows CubeSat design standards and is 6U in size (refer to the CubeSat Design Specification, http://cubesat.org/). Similarly, the term “nanosatellite” typically refers to spacecraft with gross mass in the range of 1 kg to 10 kg, but host spacecrafts larger in size will also be considered for this topic (up to 30 kg gross mass). If multiple design options exist for the size of the payload, then the trade space of size versus performance should be presented. USSOCOM will work with the vendor during the SBIR effort to identify a host bus that can both support the payload and allow for high-volume constellation deployment.

III. **OVERALL OBJECTIVE**:

The objective of this topic is the development of innovative payloads that can be hosted onboard a nanosatellite bus, for the advancement of USSOCOM capabilities in rapid intelligence collection, surveillance, and reconnaissance.

For this Direct to Phase II effort, offerors shall develop and demonstrate a prototype system determined to be a feasible solution during prior feasibility studies. The objective of this phase is to advance the technology readiness of the payload as much as possible, by refining the payload design, building a prototype payload, and testing the prototype in a relevant environment. USSOCOM will coordinate with the vendor to identify a suitable nanosatellite host bus, and one outcome of this phase would be the integration of the prototype payload with hardware and software equipment representative of the selected host bus. Subject to USSOCOM funding and user interest, a flight demonstration mission will also be considered under the scope of this phase.

Offerors interested in submitting a Direct to Phase II proposal must include documentation to substantiate that the scientific and technical merit and feasibility have been met (i.e. the small business must have performed SBIR Phase I type research and development related to the topic, but from non-SBIR funding sources). Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Projects that do not yet have the technology readiness for Phase II should instead be submitted under the companion Phase I solicitation rather than this Direct to Phase II solicitation.

IV. **Requirements**

A. **General:** The Contractor shall design, develop, fabricate, test, demonstrate, and deliver a prototype payload.

1. **Detailed Tasks**: The tasking of this Phase II effort will cover all steps necessary to build a prototype payload, demonstrate its functional performance, demonstrate its compatibility with a suitable host bus, and demonstrate its robustness to the operational environment. Subject to USSOCOM funding and user interest, a demonstration flight mission could also be considered.

Tasking under this phase could include:

* Coordinate with USSOCOM to identify a suitable nanosatellite host bus. Modify payload design as necessary to ensure compatibility with the selected host bus.
* Perform further analysis, modeling, and simulation to optimize payload design and improve performance.
* Build a prototype payload.
* Test the prototype payload and verify its capability to collect mission data on a representative target. Evaluate measured performance characteristics versus expectations and make design adjustments as necessary.
* Develop software to control the payload, collect/process mission data, and interact with the host bus.
* Demonstrate operation of the prototype payload in a representative space environment. Validate the robustness of the payload to both the space environment and the launch environment, performing necessary tests (e.g. thermal vacuum, vibration) as guided by an appropriate standard (e.g. NASA General Environmental Verification Standard).
* Integrate the prototype payload with hardware and software equipment representative of the selected host bus. Integration equipment should be procured from the host bus vendor and could be either a flat-sat, a desktop development unit, or an engineering development unit.
* Meets a maximum Technology Readiness Level 7 which is defined as “System prototyping demonstration in an operational environment: Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an air-craft, in a vehicle, or in space).”

Subject to USSOCOM funding and user interest, tasking under this phase could also include:

* Integrate a prototype payload with a flight unit of the selected host bus, in preparation for launch of a demonstration mission.
* Support on-orbit test, demonstration, and evaluation.
* Train government operators as required to command the payload, interpret mission data, and evaluate payload capabilities.

2. **COMPONENT REQUIREMENTS:** N/A

3. **Unique Item Identification:** The Contractor shall include the DoD unique item identifications or a DoD recognized unique identification equivalent for the prototypes delivered. This includes a description and cost breakout as applicable. Information on unique item identifier types is at <http://www.acq.osd.mil/dpap/UID/uid_types.html>. The guide is at <http://www.acq.osd.mil/dpap/UID/guides.htm>. This is in accordance with DFARS 252.211-7003.

4. **Ship To Address:** The Contractor shall deliver all prototypes systems delivered under this contract to the following address:

United States Special Operations Command

Attn: Travis Mills/Daniel Granados

7701 Tampa Point Blvd

MacDill AFB, FL 33621-5323

(813) 826-7402

(DODAAC: F2VUQF)

5. **SHIPPING COSTS:** The Contractor shall pay all costs to ship all product deliverables to and from the validation testing /demonstration sites and to the final delivery location.

B. **DOCUMENT DELIVERABLES:** The Contractor shall provide the following documents to the respective specified addresses during the Phase II Period of Performance:

1. Phase II Kick-Off Meeting and System Requirements Review Read-Ahead Briefing (See CDRL A001)
2. Monthly Progress Reports (See CDRL A002)
3. Financial Status Reports (See CDRL A003)
4. Test Plan (See CDRL A004)
5. Test Report (See CDRL A005)
6. Business Plans (See CDRL A006)
7. Final Technical Report (See CDRL A007)
8. Design Review Information Package (DRIP) PDR (See CDRL A008)
9. Design Review Inforation Package (DRIP) CDR (See CDRL A009)
10. System / Sub-System Specification / Interface Control Document (See CDRL A010)
11. Training Materials (See CDRL A011)
12. Software Version Description (See CDRL A012)
13. Report, Record of Meeting / Minutes / Briefing Materials See CDRL A013)

V. **TESTS AND DEMONSTRATIONS:** The Contractor shall conduct tests and demonstrations to validate that the payload meets or exceeds all the requirements specified in this Statement of Objectives.

A. The Contractor shall demonstrate that the payload meets or exceeds the performance specifications agreed upon in the Systems Requirement Review, and is able to collect data of sufficient quality on representative targets of interest.

B. The Contractor shall demonstrate that the payload is compatible for integration with a suitable host bus, considering the physical interface, power interface, and data exchange between the payload and the host.

VI. **ENVIRONMENTAL AND SAFETY:** The Contractor shall ensure the payload developed under this Statement of Work can survive both the space environment and the launch environment, and meets an appropriate set of environmental standards, such as:

A. NASA General Environmental Verification Standard (GEVS), GFSC-STD-7000, Rev A, Goddard Space Flight Center, https://standards.nasa.gov/standard/gsfc/gsfc-std-7000

VII. **GOVERNMENT FURNISHED PROPERTY (GFP) / GOVERNMENT FURNISHED PROPERTY (GFE) / GOVERNMENT FURNISHED INFORMATION (GFI):** N/A

VIII. **MEETINGS AND REVIEWS**: The Contractor shall attend the following meetings and reviews.

A. Phase II Kick-Off meeting shall be conducted not later than thirty (30) calendar days after contract award. Concurrently, or no more than thirty (30) calendar days afterwards, a System Requirements Review (SRR) shall be conducted. The Contractor shall provide the Government:

1. 1. A Phase II Kick-Off Meeting Read-Ahead no less than seven (7) calendar days prior to the Phase II Kick-Off Meeting / System Requirements Review Meeting. (See CDRL A001).

2. An initial Program Management Plan / Financial Status Report for accomplishing all objectives specified in this Statement of Objectives. (See CDRL A002 and CDRL A003).

3. Conceptual Design Drawings no less than ten (10) calendar days prior to the Phase II Kick-Off/System Requirements Review Meeting. (See CDRL A008).

B. Preliminary Design Review (PDR) - This meeting shall be conducted at the Contractor’s facility no more than one hundred and eighty (180) calendar days after Phase II contract award. The Contractor shall provide teleconference capability for those participants unable to travel. The Contractor shall provide the Government:

1. A Preliminary Design Review and Materials Read-Ahead Briefing no less than ten (10) calendar days prior to the PDR.

2. A Detailed Design Report. (See CDRL A008).

3. Trade off considerations for the design. (See CDRL A008).

4. Results of any testing to date. (See CDRL A005)

5. Resolution to any Contractor/Government issues or concerns.

6. An assessment of other potential benefits / incorporation into the subsequent design that will be provided to the Government at the follow-on Critical Design Review.

C. Critical Design Review (CDR): This teleconference meeting shall be arranged by the Contractor two (2) weeks prior to the end of the contract completion date. The Contractor shall provide the Government:

1. A Critical Design Review and Materials Read-Ahead Briefing no less than ten (10) calendar days prior to the CDR. (See CDRL A009)

2. A Detailed Design Report. (See CDRL A009)

3. Trade off considerations for the design. (See CDRL A009)

4. Results of any testing to date. (See CDRL A005)

5. Resolution to any Contractor/Government issues or concerns.

D. Phase II Close-Out Meeting: The Phase II Close-Out Meeting shall be conducted in

 no earlier than seven (7) calendar days prior to the conclusion of the Phase II Period of Performance. The Contractor shall provide the Government:

1. A briefing on the test verification. (See CDRL A005)

2. An update of the progress to date. (See CDRL A002)

3. Resolution to any Contractor/Government issues or concerns.

IX. **NOTIFICATION:** The Contractor shall notify USSOCOM no less than thirty (30) calendar days prior to tests, demonstrations and reviews at the Contractor’s facilities to ensure USSOCOM representatives can attend should they desire to do so.

X. **TRAVEL REQUIREMENTS:** The costs associated with the below travel requirements will be included in a separate Contract Line Item Number as a cost reimbursable expense. The Contractor shall comply with the Federal Acquisition Regulation 31.205-46 (<http://www.gsa.gov/perdiem>) on proposing all travel related costs. The Contractor shall include the costs associated with the following travel requirements in the proposal:

A. Phase II Kick-Off Meeting: Tampa, Florida; one (1) overnight, no more than three (3) Contractor representatives.

B. Phase II Close-Out Meeting: Tampa, Florida; one (1) overnight, no more than three (3) Contractor representatives.

XI. **MANDATORY REPORTING:**

A. The Contractor shall report ALL contractor labor hours (including subcontractor labor hours) required for performance of services provided under this contract for the U.S. Special Operations Commands via a secure data collection site. The Contractor is required to completely fill in all required data fields using the following web address: <http://www.ecmra.mil/>.

B. Reporting inputs will be for the labor executed during the period of performance during each Government fiscal year (FY), which runs October 1 through September 30. While inputs may be reported any time during the FY, all data shall be reported no later than October 31 of each calendar year, beginning with 2014. Contractors may direct questions to the help desk at help desk at: http://www.ecmra.mil.

**XIII. DISCLOSURE OF UNCLASSIFIED INFORMATION:**

A. On September 21, 2001, the Department of Defense designated Headquarters US Special Operations Command (USSOCOM) a sensitive unit, as defined by Title 10 United States Code (USC) Section 552 (10 USC 552). In keeping with this designation, unclassified information related to USSOCOM military technology acquisitions managed by USSOCOM or any of its component commands, will be designated Controlled Unclassified Information (CUI). As such, the contractor hereby unequivocally agrees that it shall not release to anyone outside the Contractor’s organization any unclassified information, regardless of medium (e.g., film, tape, document, Contractor’s external website, newspaper, magazine, journal, corporate annual report, etc.), pertaining to any part of this contract or any program related to this contract, unless the Contracting Officer has given prior written approval. Furthermore, any release of information which associates USSOCOM, Special Operation Forces (SOF), or any component command with an acquisition program, contractor, or this contract is prohibited unless specifically authorized by USSOCOM.

B. Requests for approval shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Contractor shall submit its request to the Contracting Officer at least 45 days before the proposed date for release for approval. No release of any restricted information shall be made without specific written authorization by the Contracting Officer.

C. The Contractor shall include a similar requirement in each subcontract under this contract. Subcontractors shall submit requests for authorization to release through the prime contractor to the Contracting Officer.

D. The Contractor further understands that Title 18 USC Section 701 specifically prohibits the use of the USSOCOM emblem or logo in any medium (e.g., corporate website, marketing brochure, newspaper, magazine, etc.) unless authorized in writing by USSOCOM. Forward any requests to use the USSOCOM emblem or logo through the Contracting Officer.