AMENDMENT 2

DEPARTMENT OF DEFENSE
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SBIR 23.2 Program Broad Agency Announcement (BAA)

April 19, 2023: DoD BAA issued for pre-release
May 17, 2023: DoD begins accepting proposals
June 14, 2023: Deadline for receipt of proposals no later than **12:00 p.m. ET**

The purpose of Amendment 2 is to provide additional information in sections 4.3, 5.3.f, 5.3.h and 5.3.i.

The purpose of Amendment 1 is to incorporate the following:

a. **Add Section 4.3 Disclosures Regarding Ties to People's Republic of China and Other Foreign Countries.**
b. **Replace Attachment 2: Foreign Ownership or Control Disclosure with Attachment 2: Disclosures of Foreign Affiliations or Relationships to Foreign Countries**
c. **Add Section 5.3.i (previously section 4.3), and corresponding Attachment 4: Disclosure of Funding Sources**
d. **Revisions to Section 2.2 & 5.3.h.**
e. **Removal of section 8.1.bb. (DFARS 252.209-7002, Disclosure of Ownership or Control by a Foreign Government).**
f. **Various text updates, as highlighted below.**

Participating DoD Components:

- Department of Army (Army)
- Department of Navy (Navy)
- Defense Health Agency (DHA)
- Defense Logistics Agency (DLA)
- Defense Threat Reduction Agency (DTRA)
- Office of Secretary of Defense – Quantum Science (OSD – Quantum Science)
- United States Special Operations Command (USSOCOM)

IMPORTANT

Deadline for Receipt: Complete proposals must be certified and submitted in DSIP no later than **12:00 PM** ET on **June 14, 2023.** Proposals submitted after 12:00 p.m. ET will not be evaluated. The final proposal submission includes successful completion of all firm level forms, all required volumes, and electronic corporate official certification. Please plan to submit proposals as early as possible in order to avoid unexpected delays due to high volume of traffic during the final hours before the BAA close. DoD is not responsible for missed proposal submission due to system latency.

Classified proposals will not be accepted under the DoD SBIR Program.

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. Proposing Small Business Concerns are required to register for a Login.gov account and link it to their DSIP account. See section 4.16 for more information regarding registration.

The Small Business Administration (SBA), through its SBIR/STTR Policy Directive, purposely departs from normal Government solicitation formats and requirements, thus authorizing agencies to simplify the SBIR/STTR award process and minimize the regulatory burden on small business. Therefore, consistent with the SBA SBIR/STTR Policy Directive, the Department of Defense is soliciting proposals as a Broad Agency Announcement (BAA). The DoD SBIR/STTR Programs follow the policies and practices of the SBA SBIR/STTR Policy Directive, current version. The guidelines presented in this BAA incorporate and make use of the flexibility of the SBA SBIR/STTR Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to the DoD and the private sector. The SBIR/STTR Policy Directive is available HERE.

AMENDMENT 2

IMPORTANT (continued)

SBIR/STTR Updates and Notices: To be notified of SBIR/STTR opportunities and to receive e-mail updates on the DoD SBIR and STTR Programs, you are invited to subscribe to our Listserv by visiting https://www.dodsbirsttr.mil/submissions/login and clicking "DSIP Listserv" located under Quick Links.

This BAA incorporates MANDATORY foreign disclosure requirements and other important programmatic changes as required by the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183). These updates can be found in sections 2.2, 2.5, 3.0, 4.2.e., 4.3, 6.0, 8.2, and Attachment 2. Small business concerns are highly encouraged to review the full BAA to remain apprised of any additional recent programmatic changes.

Questions: Please refer to the DSIP Customer Support Document for general information regarding the DoD SBIR/STTR process in DSIP. For additional assistance with the DSIP application, please visit the Learning & Support section of the DSIP at https://www.dodsbirsttr.mil/submissions/learning-support/. Email DSIP Support at DoDSBIRSupport@reisystems.com only for further assistance with issues pertaining directly to the DSIP application. Questions submitted to DSIP Support will be addressed in the order received during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). **See section 4.15 for further information on where to direct questions regarding instructions and topics in this BAA**.

TABLE OF CONTENTS

AMENDMENT 2

1.0 INTRODUCTION

Army, Navy, DHA, DLA, DTRA, OSD – Quantum Science, and USSOCOM, hereafter referred to as DoD Components, invite proposing small business concerns to submit proposals under this BAA for the Small Business Innovation Research (SBIR) Program. Proposing Small Business Concerns with the capability to conduct research and development (R&D) in any of the defense-related topic areas described in this BAA and to commercialize the results of that R&D are encouraged to participate.

This BAA is for Phase I proposals only unless the Component is participating in the **Direct to Phase II Program**. Navy, DLA, OSD – Quantum Science, and USSOCOM are offering Direct to Phase II topics for this BAA – see the Component-specific instructions for more information.

A separate BAA will not be issued requesting Phase II proposals, and unsolicited proposals will not be accepted. All proposing small business concerns that receive a Phase I award originating from this BAA will be eligible to participate in Phase II competitions and potential Phase III awards. DoD Components will notify Phase I awardees of the Phase II proposal submission requirements. Submission of Phase II proposals will be in accordance with instructions provided by individual Components. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the awarding DoD Component either in the Phase I award or by subsequent notification. If a proposing small business concern submits their Phase II proposal prior to the dates provided by the individual Components, it may be rejected without evaluation.

DoD is not obligated to make any awards under Phase I, Phase II, or Phase III, and all awards are subject to the availability of funds. DoD is not responsible for any monies expended by the proposing small business concern before the issuance of any award. Proposals must conform to the terms of this announcement.

2.0 PROGRAM DESCRIPTION

2.1 Objectives

The objectives of the DoD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development results.

2.2 Due Diligence Program to Assess Security Risks

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. The full text of the SBIR and STTR Extension Act of 2022 is available at https://www.congress.gov/117/plaws/publ183/PLAW-117publ183.pdf.

As previously stated, the DoD SBIR/STTR Programs follow the policies and practices of the Small Business Administration (SBA) SBIR/STTR Policy Directive. The SBA revisions to the Policy Directive are in effect as of May 3, 2023. The Federal Register Notice is available at: https://www.federalregister.gov/documents/2023/04/03/2023-06870/small-business-innovation-research-program-and-small-business-technology-transfer-program-policy. This revision is incorporated into this BAA, including the utilization of the Appendix III, Disclosure Questions, as Attachment 2 “Disclosures of Foreign Affiliations or Relationships to Foreign Countries”.

AMENDMENT 2

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. The Department will use information provided by the small business concern in in response to the Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) and the proposal to conduct a risk-based due diligence review on the cybersecurity practices, patent analysis, employee analysis, and foreign ownership of a small business concern, including the financial ties and obligations (which shall include surety, equity, and debt obligations) of the small business concern and employees of the small business concern to a foreign country, foreign person, or foreign entity. The Department will also assess proposals utilizing open-source analysis and analytical tools, for the nondisclosures of the information set forth in 15 U.S.C. 638(g)(13).

DoD has partnered with Project Spectrum to provide an online course on Understanding Foreign Ownership, Control, or Influence (FOCI). This course defines FOCI, explains what it means to be under FOCI, and details FOCI's effect on a company seeking initial or continued eligibility for access to a federally funded award. Small business concerns can register and access this course by following the instructions below:

1. Go to projectspectrum.io
2. Click “Profile/Dashboard” in the top right and then click “Sign Up” from the dropdown menu.
3. Follow the instructions to sign up for an account. Descriptions of the account types are provided below each option.
4. Verify your email by entering the code sent to the email address you provided when signing up.
5. Log in to Project Spectrum by clicking “Profile/Dashboard > Login” in the top right.
6. Find the Training Course on “Understanding Foreign Ownership, Control, or Influence (FOCI)” by clicking “Courses > Training Courses”
7. Copy the provided password.
8. Click on the course and log in to Encite.io using your email address and the copied password.
9. Enroll in the course and click “Enter” to begin.

For assistance with registration or access to the Project Spectrum website, please contact support@projectspectrum.io.

2.3 OUSD(R&E) Critical Technology Areas

Each DoD Component develops SBIR and STTR topics that are mission-oriented to their programs, however topics generally align with the OUSD(R&E) Critical Technology Areas. While many technologies may cross between these categories, these areas represent the broad and different approaches that are required to advance technologies crucial to the Department. By focusing efforts and investments into these critical technology areas, the Department will accelerate transitioning key capabilities to the Military Services and Combatant Commands.

OUSD(R&E) Critical Technology Areas:

- FutureG
- Trusted AI and Autonomy
- Biotechnology
- Advanced Computing and Software
- Integrated Sensing and Cyber
- Directed Energy (DE)
- Hypersonics
- Microelectronics
- Integrated Network Systems-of-Systems
- Quantum Science

- Space Technology
- Renewable Energy Generation and Storage
- Advanced Materials
- Human-Machine Interfaces

Below are additional technology areas supporting DoD Component-specific mission-critical areas:

- Advanced Infrastructure & Advanced Manufacturing
- Combat Casualty Care
- Emerging Threat Reduction
- Military Infectious Diseases
- Military Operational Medicine
- Mission Readiness & Disaster Preparedness
- Nuclear
- Sustainment & Logistics

Full descriptions of the above technology areas can be reviewed here: https://media.defense.gov/2023/Mar/21/2003183351/-1/-1/1/OUSDRE_SBIR_STTR_CRITICAL_TECH_AREAS.PDF.

2.4 Three Phase Program

The SBIR Program is a three-phase program. Phase I is to determine, to the extent possible, the scientific, technical, and commercial merit and feasibility of ideas submitted under the SBIR Program. Phase I awards are made in accordance with the SBA Policy Directive guidelines, current version. The period of performance is generally between six to twelve months with twelve months being the maximum period allowable. Proposals should concentrate on research or research and development which will significantly contribute to proving the scientific and technical feasibility, and commercialization potential of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. Proposing small business concerns are encouraged to consider whether the research or research and development being proposed to DoD Components also has private sector potential, either for the proposed application or as a base for other applications.

Phase II awards will be made to proposing small business concerns on the basis of results of their Phase I effort and/or the scientific merit, technical merit, and commercialization potential of the Phase II proposal. Phase II awards are made in accordance with the SBA Policy Directive guidelines, current version. The period of performance is generally 24 months. Phase II is the principal research or research and development effort and is expected to produce a well-defined deliverable prototype. A Phase II contractor may receive up to one additional, sequential Phase II award for continued work on the project.

Under Phase III, the Proposer is required to obtain funding from either the private sector, a non-SBIR Government source, or both, to develop the prototype into a viable product or non-R&D service for sale in military or private sector markets. SBIR Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Phase III work is typically oriented towards commercialization of SBIR research or technology.

2.5 Program on Innovation Open Topics

Section 7 of the SBIR and STTR Extension Act of 2022 requires the Department of Defense to establish innovation open topic activities in order to—

(A) increase the transition of commercial technology to the Department of Defense;
(B) expand the small business nontraditional industrial base;
(C) increase commercialization derived from investments of the Department of Defense; and

(D) expand the ability for qualifying small business concerns to propose technology solutions to meet the needs of the Department of Defense.

Unlike conventional topics, which specify the desired technical objective and output, open topics can use generalized mission requirements or specific technology areas to adapt commercial products or solutions to close capability gaps, improve performance, or provide technological advancements in existing capabilities.

A small business concern may only submit one (1) proposal to each open topic. If more than one proposal from a small business concern is received for a single open topic, only the most recent proposal to be certified and submitted prior to the submission deadline will receive an evaluation. All prior proposals submitted by the small business concern for the same open topic will be marked as nonresponsive and will not receive an evaluation.

Open topics released under this BAA will be clearly identified as such in the title and objective of the topic. Proposal preparation instructions for open topics may vary significantly across DoD Components. Proposing small business concerns are advised to carefully read and follow all instructions from the DoD Component for the open topic of interest. Unless specifically noted in the Component instructions, all requirements outlined in this BAA remain in effect for open topics.

3.0 DEFINITIONS

The following definitions from the SBA SBIR/STTR Policy Directive, the Federal Acquisition Regulation (FAR), and other cited regulations apply for the purposes of this BAA:

Commercialization

The process of developing products, processes, technologies, or services and the production and delivery (whether by the originating party or others) of the products, processes, technologies, or services for sale to or use by the Federal government or commercial markets.

Cooperative Research and Development

Research and development conducted jointly by a small business concern and a research institution. For purposes of the STTR Program, 40% of the work is performed by the small business concern, and not less than 30% of the work is performed by the single research institution. For purposes of the SBIR Program, this refers to work conducted by a research institution as a subcontractor to the small business concern. At least two-thirds of the research and/or analytical work in Phase I must be conducted by the proposing small business concern.

Covered Individual

An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research and development (R&D) project proposed to be carried out with a Federally funded award from DoD. DoD has further designated covered individuals as including all proposed key personnel.

AMENDMENT 2

Essentially Equivalent Work

Work that is substantially the same research, which is proposed for funding in more than one contract proposal or grant application submitted to the same Federal agency or submitted to two or more different Federal agencies for review and funding consideration; or work where a specific research objective and the research design for accomplishing the objective are the same or closely related to another proposal or award, regardless of the funding source.

Export Control

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.

NOTE: Export control compliance statements found in the individual Component-specific proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

Federal Laboratory

As defined in 15 U.S.C. §3703, means any laboratory, any federally funded research and development center (FFRDC), or any center established under 15 U.S.C. §§ 3705 & 3707 that is owned, leased, or otherwise used by a Federal agency and funded by the Federal Government, whether operated by the Government or by a contractor.

Federally Funded Award

A Phase I, Phase II (including Direct to Phase II, sequential Phase II/subsequent Phase II and cross-agency Phase II), or Phase III SBIR or STTR award made using a funding agreement.

Foreign Affiliation

As defined in 15 U.S.C. § 638(e)(16), foreign affiliation means a funded or unfunded academic, professional, or institutional appointment or position with a foreign government or government-owned entity, whether full-time, part-time, or voluntary (including adjunct, visiting, or honorary). This includes appointments or positions deemed adjunct, visiting, or honorary with research institutions located in a foreign country of concern.

Foreign Country of Concern

As defined in 15 U.S.C. § 638(e)(17), foreign country of concern means the People's Republic of China, the Democratic People's Republic of Korea, the Russian Federation, the Islamic Republic of Iran, or any other country determined to be a country of concern by the Secretary of State.

Foreign Entity

Foreign entity means any branch, partnership, group or sub-group, association, estate, trust, corporation or division of a corporation, non-profit, academic institution, research center, or organization established, directed, or controlled by foreign owners, foreign investors, foreign management, or a foreign government.

Foreign Government

Foreign government means any government or governmental body, organization, or instrumentality, including government owned-corporations, other than the United States Government or United States state, territorial, tribal, or jurisdictional governments or governmental bodies. The term includes, but is not limited to, non-United States national and subnational governments, including their respective departments, agencies, and instrumentalities.

Foreign Nationals

Foreign Nationals (also known as Foreign Persons) as defined by 22 CFR 120.16 means any natural person who is not a lawful permanent resident as defined by 8 U.S.C. § 1101(a)(20) or who is not a protected individual as defined by 8 U.S.C. § 1324b(a)(3). It also means any foreign corporation, business association, partnership, trust, society or any other entity or group that is not incorporated or organized to do business in the United States, as well as international organizations, foreign governments and any agency or subdivision of foreign governments (e.g., diplomatic missions).

“Lawfully admitted for permanent residence” means the status of having been lawfully accorded the privilege of residing permanently in the United States as an immigrant in accordance with the immigration laws, such status not having changed.

"Protected individual’’ means an individual who (A) is a citizen or national of the United States, or (B) is an alien who is lawfully admitted for permanent residence, is granted the status of an alien lawfully admitted for temporary residence under 8 U.S.C. § 1160(a) or 8 U.S.C. § 1255a(a)(1), is admitted as a refugee under 8 U.S.C. § 1157, or is granted asylum under Section 8 U.S.C. § 1158; but does not include (i) an alien who fails to apply for naturalization within six months of the date the alien first becomes eligible (by virtue of period of lawful permanent residence) to apply for naturalization or, if later, within six months after November 6, 1986, and (ii) an alien who has applied on a timely basis, but has not been naturalized as a citizen within 2 years after the date of the application, unless the alien can establish that the alien is actively pursuing naturalization, except that time consumed in the Service's processing the application shall not be counted toward the 2-year period.

Fraud, Waste and Abuse

a. **Fraud** includes any false representation about a material fact or any intentional deception designed to deprive the United States unlawfully of something of value or to secure from the United States a benefit, privilege, allowance, or consideration to which an individual or business is not entitled.
b. **Waste** includes extravagant, careless or needless expenditure of Government funds, or the consumption of Government property, that results from deficient practices, systems, controls, or decisions.
c. **Abuse** includes any intentional or improper use of Government resources, such as misuse of rank, position, or authority or resources.
d. The SBIR Program training related to Fraud, Waste and Abuse is available at: https://www.sbir.gov/tutorials/fraud-waste-abuse/tutorial-1. See Section 4.17 for reporting Fraud, Waste and Abuse.

AMENDMENT 2

Funding Agreement

Any contract, grant, or cooperative agreement entered into between any Federal Agency and any small business concern for the performance of experimental, developmental, or research work, including products or services, funded in whole or in part by the Federal Government. Only contracts and other transaction authority (OTA) agreements will be used by DoD Components for SBIR awards.

Historically Black Colleges and Universities and Minority Institutions (HBCU/MI)

Listings for the Historically Black Colleges and Universities (HBCU) and Minority Institutions (MI) are available through the Department of Education Web site, http://www.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

Certified HUBZone Small Business Concern

An SBC that has been certified by SBA under the Historically Underutilized Business Zones (HUBZone) Program (13 C.F.R. § 126) as a HUBZone firm listed in the Dynamic Small Business Search (DSBS).

Malign Foreign Talent Recruitment Program

As defined in 42 U.S.C § 19237, the term "malign foreign talent recruitment program" means-

(A) any program, position, or activity that includes compensation in the form of cash, in-kind compensation, including research funding, promised future compensation, complimentary foreign travel, things of non de minimis value, honorific titles, career advancement opportunities, or other types of remuneration or consideration directly provided by a foreign country at any level (national, provincial, or local) or their designee, or an entity based in, funded by, or affiliated with a foreign country, whether or not directly sponsored by the foreign country, to the targeted individual, whether directly or indirectly stated in the arrangement, contract, or other documentation at issue, in exchange for the individual-
  - (i) engaging in the unauthorized transfer of intellectual property, materials, data products, or other nonpublic information owned by a United States entity or developed with a Federal research and development award to the government of a foreign country or an entity based in, funded by, or affiliated with a foreign country regardless of whether that government or entity provided support for the development of the intellectual property, materials, or data products;
  - (ii) being required to recruit trainees or researchers to enroll in such program, position, or activity;
  - (iii) establishing a laboratory or company, accepting a faculty position, or undertaking any other employment or appointment in a foreign country or with an entity based in, funded by, or affiliated with a foreign country if such activities are in violation of the standard terms and conditions of a Federal research and development award;
  - (iv) being unable to terminate the foreign talent recruitment program contract or agreement except in extraordinary circumstances;
  - (v) through funding or effort related to the foreign talent recruitment program, being limited in the capacity to carry out a research and development award or required to engage in work that would result in substantial overlap or duplication with a Federal research and development award;
  - (vi) being required to apply for and successfully receive funding from the sponsoring foreign government's funding agencies with the sponsoring foreign organization as the recipient;
  - (vii) being required to omit acknowledgment of the recipient institution with which the individual is affiliated, or the Federal research agency sponsoring the research and development award,

contrary to the institutional policies or standard terms and conditions of the Federal research and development award;

(viii) being required to not disclose to the Federal research agency or employing institution the participation of such individual in such program, position, or activity; or

(ix) having a conflict of interest or conflict of commitment contrary to the standard terms and conditions of the Federal research and development award; and

(B) a program that is sponsored by-

(i) a foreign country of concern or an entity based in a foreign country of concern, whether or not directly sponsored by the foreign country of concern;

(ii) an academic institution on the list developed under section 1286(c)(8) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232) ; or

(iii) a foreign talent recruitment program on the list developed under section 1286(c)(9) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232).

Performance Benchmark Requirements

Companies with multiple SBIR/STTR awards must meet minimum performance requirements to be eligible to apply for a new Phase I or Direct-to-Phase II award. The purpose of these requirements is to ensure that Phase I applicants that have won multiple prior SBIR/STTR awards are making progress towards commercializing the work done under those awards. The Phase I to Phase II transition rate addresses the extent to which an awardee progresses a project from Phase I to Phase II. The commercialization benchmark addresses the extent to which an awardee has moved past Phase II work towards commercialization.

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) amended the application of these benchmarks for more experienced firms. Detailed information on benchmark calculations and increased performance standards for more experienced firms can be found at https://www.sbir.gov/performance-benchmarks.

Personal Conflict of Interest

A situation in which an individual has a financial interest, personal activity, or relationship that could impair the employee’s ability to act impartially and in the best interest of the Government when performing under the contract. (A de minimis interest that would not "impair the employee’s ability to act impartially and in the best interest of the Government" is not covered under this definition.)

Among the sources of personal conflicts of interest are-
(i) Financial interests of the covered employee, of close family members, or of other members of the covered employee’s household;
(ii) Other employment or financial relationships (including seeking or negotiating for prospective employment or business); and
(iii) Gifts, including travel.

Financial interests referred to in paragraph (1) of this definition may arise from-
(i) Compensation, including wages, salaries, commissions, professional fees, or fees for business referrals;
(ii) Consulting relationships (including commercial and professional consulting and service arrangements, scientific and technical advisory board memberships, or serving as an expert witness in litigation);

(iii) Services provided in exchange for honorariums or travel expense reimbursements;
(iv) Research funding or other forms of research support;
(v) Investment in the form of stock or bond ownership or partnership interest (excluding diversified mutual fund investments);
(vi) Real estate investments;
(vii) Patents, copyrights, and other intellectual property interests; or
(viii) Business ownership and investment interests.

Principal Investigator

The principal investigator/project manager is the one individual designated by the applicant to provide the scientific and technical direction to a project supported by the funding agreement.

For both Phase I and Phase II, the primary employment of the principal investigator must be with the proposing small business firm at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the principal investigator's time is spent in the employ of the small business. This precludes full-time employment with another organization. Occasionally, deviations from this requirement may occur, and must be approved in writing by the contracting officer after consultation with the agency SBIR/STTR Program Manager/Coordinator. Further, a proposing small business concern or research institution may replace the principal investigator on an SBIR/STTR Phase I or Phase II award, subject to approval in writing by the contracting officer.

Proprietary Information

Proprietary information is any information that a small business concern considers to be non-public information that is owned by the small business concern and is marked accordingly.

Research Institution

Any organization located in the United States that is:

a. A university.
b. A nonprofit institution as defined in Section 4(5) of the Stevenson-Wydler Technology Innovation Act of 1980.
c. A contractor-operated federally funded research and development center, as identified by the National Science Foundation in accordance with the government-wide Federal Acquisition Regulation issued in accordance with Section 35(c)(1) of the Office of Federal Procurement Policy Act. A list of eligible FFRDCs is available at: https://www.nsf.gov/statistics/ffrdclist/.

Research or Research and Development

Any activity that is:

a. A systematic, intensive study directed toward greater knowledge or understanding of the subject studied.
b. A systematic study directed specifically toward applying new knowledge to meet a recognized need; or
c. A systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

AMENDMENT 2

Research Involving Animal Subjects

All activities involving animal subjects shall be conducted in accordance with DoDI 3216.01 “Use of Animals in DoD Programs,” 9 C.F.R. parts 1-4 “Animal Welfare Regulations,” National Academy of Sciences Publication “Guide for the Care & Use of Laboratory Animals,” as amended, and the Department of Agriculture rules implementing the Animal Welfare Act (7 U.S.C. §§ 2131-2159), as well as other applicable federal and state law and regulation and DoD instructions.

“Animal use” protocols apply to all activities that meet any of the following criteria:

a. Any research, development, test, evaluation or training, (including experimentation) involving an animal or animals.
b. An animal is defined as any living or dead, vertebrate organism (non-human) that is being used or is intended for use in research, development, test, evaluation or training.
c. A vertebrate is a member of the subphylum Vertebrata (within the phylum Chordata), including birds and cold-blooded animals.

See DoDI 3216.01 for definitions of these terms and more information about the applicability of DoDI 3216.01 to work involving animals.

Research Involving Human Subjects

All research involving human subjects shall be conducted in accordance with 32 C.F.R. § 219 “The Common Rule,” 10 U.S.C. § 980 “Limitation on Use of Humans as Experimental Subjects,” and DoDI 3216.02 “Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research,” as well as other applicable federal and state law and regulations, and DoD component guidance. Proposing small business concerns must be cognizant of and abide by the additional restrictions and limitations imposed on the DoD regarding research involving human subjects, specifically as they regard vulnerable populations (DoDI 3216.02), recruitment of military research subjects (DoDI 3216.02), and informed consent and surrogate consent (10 U.S.C. § 980) and chemical and biological agent research (DoDI 3216.02). Food and Drug Administration regulation and policies may also apply.

“Human use” protocols apply to all research that meets any of the following criteria:

a. Any research involving an intervention or an interaction with a living person that would not be occurring or would be occurring in some other fashion but for this research.
b. Any research involving identifiable private information. This may include data/information/specimens collected originally from living individuals (broadcast video, web-use logs, tissue, blood, medical or personnel records, health data repositories, etc.) in which the identity of the subject is known, or the identity may be readily ascertained by the investigator or associated with the data/information/specimens.

See DoDI 3216.02 for definitions of these terms and more information about the applicability of DoDI 3216.02 to research involving human subjects.

Research Involving Recombinant DNA Molecules

Any recipient performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules shall comply with the National Institutes of Health Guidelines for Research Involving Recombinant DNA Molecules, dated January 2011, as amended. The guidelines can be found at: https://osp.od.nih.gov/wp-content/uploads/2016/05/NIH_Guidelines.pdf. Recombinant DNA is defined as (i) molecules that are constructed outside living cells by joining natural or synthetic

DNA segments to DNA molecules that can replicate in living cells or (ii) molecules that result from the replication of those described in (i) above.

Service-Disabled Veteran-Owned Small Business (SDVOSB)

A small business concern owned and controlled by a Service-Disabled Veteran or Service-Disabled Veterans, as defined in Small Business Act 15 USC § 632(q)(2) and SBA's implementing SDVOSB regulations (13 CFR 125).

Small Business Concern (SBC)

A concern that meets the requirements set forth in 13 C.F.R. § 121.702 (available here).

An SBC must satisfy the following conditions on the date of award:

a. Is organized for profit, with a place of business located in the United States, which operates primarily within the United States or which makes a significant contribution to the United States economy through payment of taxes or use of American products, materials or labor;
b. Is in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that if the concern is a joint venture, each entity to the venture must meet the requirements set forth in paragraph (c) below;
c. Is more than 50% directly owned and controlled by one or more individuals (who are citizens or permanent resident aliens of the United States), other small business concerns (each of which is more than 50% directly owned and controlled by individuals who are citizens or permanent resident aliens of the United States), or any combination of these; and
d. Has, including its affiliates, not more than 500 employees. (For explanation of affiliate, see www.sba.gov/size.)

Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by an awardee of a funding agreement calling for supplies or services for the performance of the original funding agreement. This includes consultants.

Subcontractor

Subcontractor means any supplier, distributor, vendor, firm, academic institution, research center, or other person or entity that furnishes supplies or services pursuant to a subcontract, at any tier.

United States

"United States" means the fifty states, the territories and possessions of the Federal Government, the Commonwealth of Puerto Rico, the Republic of the Marshall Islands, the Federated States of Micronesia, the Republic of Palau, and the District of Columbia.

Women-Owned Small Business Concern

An SBC that is at least 51% owned by one or more women, or in the case of any publicly owned business, at least 51% of the stock is owned by women, and women control the management and daily business operations.

AMENDMENT 2

4.0 PROPOSAL FUNDAMENTALS

4.1 Introduction

The proposal must provide sufficient information to demonstrate to the evaluator(s) that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria. The proposed research or research and development must be responsive to the chosen topic, although it need not use the exact approach specified in the topic. Anyone contemplating a proposal for work on any specific topic should determine:

a. The technical approach has a reasonable chance of meeting the topic objective,
b. This approach is innovative, not routine, with potential for commercialization and
c. The proposing small business concern has the capability to implement the technical approach, i.e., has or can obtain people and equipment suitable to the task.

Please note, **this BAA is for Phase I proposals only** unless the Component is participating in the **Direct to Phase II Program**.

a. Direct to Phase II

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019,Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows DoD to make a SBIR Phase II award to a small business concern with respect to a project, without regard to whether the small business concern was provided an award under Phase I of the SBIR program with respect to such project. DoD does not guarantee Direct to Phase II opportunities will be offered in future BAAs.

Each eligible topic requires that proposing small business concerns provide documentation to demonstrate feasibility described in the Phase I section of the topic has been met. **Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.** Work submitted within the feasibility documentation must have been substantially performed by the proposing small business concern and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposing small business concern must either own the IP or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work.

If the proposing small business concern fails to demonstrate technical merit and feasibility equivalent to the Phase I level as described in the associated topic, the related Phase II proposal will not be accepted or evaluated, in accordance with the Component-specific Direct to Phase II instructions.

Please refer to the Component-specific Direct to Phase II instructions for full details regarding Component Direct to Phase II processes and proposal preparation requirements.

4.2 Proposing Small Business Concern Eligibility and Performance Requirements

a. Each proposing small business concern must qualify as a small business concern as defined by 13 C.F.R §§ 701-705 at time of award and certify to this in the Cover Sheet section of the proposal. The eligibility requirements for the SBIR/STTR programs are unique and do not correspond to those of other small business programs (see Section 3 of this BAA). Proposing small business concern must meet eligibility requirements for Small Business Ownership and Control (see 13 CFR § 121.702).
b. A minimum of <u>two-thirds</u> of the research and/or analytical work in Phase I must be conducted by the proposing small business concern. For Phase II, a minimum of one-half (50%) of the research

and/or analytical work must be performed by the proposing small business concern. The percentage of work is measured by both direct and indirect costs. Occasionally, deviations from these SBIR requirements may occur, and must be approved in writing by the Funding Agreement officer after consultation with the agency SBIR/STTR program manager/coordinator. For more information on the percentage of work calculation during proposal submission, refer to section 5.3.

c. For both Phase I and II, the primary employment of the principal investigator must be with the proposing small business concern at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Primary employment with a small business concern precludes full-time employment at another organization.

d. For both Phase I and Phase II, all research or research and development work must be performed by the small business concern and its subcontractors in the United States.

e. **Benchmarks**. Proposing small business concern with prior SBIR/STTR awards must meet two performance benchmark requirements as determined by the Small Business Administration (SBA) on June 1 each year.

   (1) Phase I to Phase II Transition Rate: For all proposing small business concerns with greater than 20 Phase I awards over the past five fiscal years excluding the most recent year, the ratio of Phase II awards to Phase I awards must be at least 0.25.

   (2) Commercialization Benchmark: For all proposing small business concerns with greater than 15 Phase II awards over the last 10 fiscal years excluding the last two years, the proposing small business concern must have received, to date, an average of at least $100,000 of sales and/or investments per Phase II award received or have received a number of patents resulting from the SBIR work equal to or greater than 15% of the number of Phase II awards received during the period.

The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) amended the application of these benchmarks for more experienced firms. Detailed information on benchmark calculations, increased performance standards for more experienced firms and consequence of failure to meet benchmarks can be found at https://www.sbir.gov/performance-benchmarks.

As defined by the SBIR/STTR Policy Directive, Department of the Army, Department of the Navy, and Department of the Air Force each constitute its own Federal agency, and the remaining DoD Components fall under the executive agency of the Department of Defense. Companies that fail to meet either of the benchmarks under the Increased Performance Standards for more Experienced Firms may not receive more than an overall total of 80 awards from DoD, as detailed in the breakdown below:

Army – 20 total Phase I and Direct to Phase II awards
Navy – 20 total Phase I and Direct to Phase II awards
Air Force – 20 total Phase I and Direct to Phase II awards
All other DoD Components - 20 Phase I and Direct to Phase II awards, combined

4.3 Disclosures Regarding Ties to People's Republic of China and Other Foreign Countries

Each proposing small business concern is required to complete Attachment 2 of this BAA, "Disclosures of Foreign Affiliations or Relationships to Foreign Countries" and upload the form to Volume 5, Supporting Documents. **Proposals that do not include Attachment 2 in Volume 5 will be deemed noncompliant and will not receive an evaluation.** The disclosure requires the following information:

(A) the identity of all owners and covered individuals of the small business concern who are a party to any foreign talent recruitment program of any foreign country of concern, including the People's Republic of China;
(B) the existence of any joint venture or subsidiary of the small business concern that is based in, funded by, or has a foreign affiliation with any foreign country of concern, including the People's Republic of China;
(C) any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity;
(D) whether the small business concern is wholly owned in the People's Republic of China or another foreign country of concern;
(E) the percentage, if any, of venture capital or institutional investment by an entity that has a general partner or individual holding a leadership role in such entity who has a foreign affiliation with any foreign country of concern, including the People's Republic of China;
(F) any technology licensing or intellectual property sales to a foreign country of concern, including the People's Republic of China, during the five-year period preceding submission of the proposal; and
(G) any foreign entity, offshore entity, or entity outside the United States related to the small business concern.

After reviewing the above listed disclosures of the proposing small business concern, and if determined appropriate by the DoD, the Department may ask the small business concern may to provide true copies of any contractual or financial obligation or other agreement specific to a business arrangement or joint-venture like arrangement with an enterprise owned by a foreign state or any foreign entity in effect during the five-year period preceding submission of the proposal with respect to which the small business concern made the disclosures.

4.4 Joint Ventures

<u>Joint ventures</u> and <u>limited partnerships</u> are permitted, provided that the <u>entity created</u> qualifies as a small business in accordance with the Small Business Act, 13 U.S.C. § 121.701. Proposing small business concern must disclose joint ventures with existing (or planned) relationships/partnerships with any foreign entity or any foreign government-controlled companies.

A small business joint venture entity must submit, with its proposal, the representation required in paragraph (c) of FAR solicitation provision 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services, and paragraph (c) of FAR solicitation provision 52.219-1, Small Business Program Representations, in accordance with 52.204-8(d) and 52.212-3(b) for the following categories:

(A) Small business;
(B) Service-disabled veteran-owned small business;
(C) Women-owned small business (WOSB) under the WOSB Program;
(D) Economically disadvantaged women-owned small business under the WOSB Program; or
(E) Historically underutilized business zone small business.

These representations can be found as Attachment 3 to this BAA and must be uploaded to Volume 5, Supporting Documents of the proposal submission in DSIP, if applicable.

AMENDMENT 2

4.5 Majority Ownership in Part by Multiple Venture Capital, Hedge Fund, and Private Equity Firms

Unless otherwise noted in the participating Component instructions, proposing small business concerns that are owned in majority part by multiple venture capital operating companies (VCOCs), hedge funds, or private equity funds are ineligible to submit applications or receive awards for opportunities in this BAA. Component instructions will specify if participation by a small business majority owned in part by VCOCs, hedge funds, or private equity funds is allowable for a specific topic in the BAA. If a Component authorizes such participation, any proposing small business concern that is owned, in whole in or in part, by any VCOC, hedge fund, and/or private equity fund must identify each foreign national, foreign entity, or foreign government holding or controlling greater than a 5% equity stake in the proposing small business concern, whether such equity stake is directly or indirectly held. The proposing small business concern must also identify any and all of its ultimate parent owner(s) and any other entities and/or individuals owning more than a 5% equity stake in its chain of ownership.

4.6 Conflicts of Interest

Contract awards to proposing small business concern owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees, which may be a violation of federal law.

4.7 Organizational Conflicts of Interest (OCI)

FAR 9.5 Requirements
In accordance with FAR 9.5, proposing small business concerns are required to identify and disclose all facts relevant to potential OCIs involving the proposing small business concern's organization and any proposed team member (sub-awardee, consultant). Under this Section, the proposing small business concern is responsible for providing this disclosure with each proposal submitted to the BAA. The disclosure must include the proposing small business concern's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposing small business concern has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposing small business concern's judgment and to prevent the proposing small business concern from having unfair competitive advantage. The OCI mitigation plan will specifically discuss the disclosed OCI in the context of each of the OCI limitations outlined in FAR 9.505-1 through FAR 9.505-4.

Agency Supplemental OCI Policy
In addition, DoD Components may have a supplemental OCI policy that prohibits contractors/performers from concurrently providing Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS) or similar support services and being a technical performer. Therefore, as part of the FAR 9.5 disclosure requirement above, a proposing small business concern must affirm whether the proposing small business concern or any proposed team member (sub-awardee, consultant) is providing SETA, A&AS, or similar support to any DoD Component office(s) under: (a) a current award or sub-award; or (b) a past award or sub-award that ended within one calendar year prior to the proposal's submission date.
If SETA, A&AS, or similar support is being or was provided to any DoD Component office(s), the proposal must include:

- The name of the DoD Component office receiving the support;
- The prime contract number;
- Identification of proposed team member (sub-awardee, consultant) providing the support;

and

- An OCI mitigation plan in accordance with FAR 9.5.

Government Procedures

In accordance with FAR 9.503, 9.504 and 9.506, the Government will evaluate OCI mitigation plans to avoid, neutralize or mitigate potential OCI issues before award and to determine whether it is in the Government's interest to grant a waiver. The Government will only evaluate OCI mitigation plans for proposals that are determined selectable under the BAA evaluation criteria and funding availability.

The Government may require proposing small business concerns to provide additional information to assist the Government in evaluating the proposing small business concern's OCI mitigation plan.

If the Government determines that a proposer failed to fully disclose an OCI; or failed to provide the affirmation of Government support as described above; or failed to reasonably provide additional information requested by the Government to assist in evaluating the proposer's OCI mitigation plan, the Government may reject the proposal and withdraw it from consideration for award.

4.8 Classified Proposals

Classified proposals will not be accepted under the DoD SBIR Program. If topics will require classified work during Phase II, the proposing small business concern must have a facility clearance in order to perform the Phase II work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Counterintelligence and Security Agency (DCSA) website at: https://www.dcsa.mil/mc/ctp/fc/.

4.9 Research Involving Human Subjects

All research involving human subjects, to include use of human biological specimens and human data, shall comply with the applicable federal and state laws and agency policy/guidelines for human subject protection (see Section 3).

Institutions to be awarded funding for research involving human subjects must provide documentation of a current Federal Assurance of Compliance with Federal regulations for human subject protection, for example a Department of Health and Human Services, Office for Human Research Protections Federal-wide Assurance (http://www.hhs.gov/ohrp). Additional Federal Assurance documentation may also be requested by the awarding DoD Component. All institutions engaged in human subject research, to include subcontractors, must also have a valid Assurance. In addition, personnel involved in human subjects research must provide documentation of completing appropriate training for the protection of human subjects. Institutions proposing to conduct human subject research that meets one of the exemption criteria in 32 CFR 219.101 are not required to have a Federal Assurance of Compliance. proposing small business concerns should clearly segregate research activities involving human subjects from other research and development activities in their proposal.

If selected, institutions must also provide documentation of Institutional Review Board (IRB) approval or a determination from an appropriate official in the institution that the work meets one of the exemption criteria with 32 CFR 219. As part of the IRB review process, evidence of appropriate training for all investigators should accompany the protocol. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and benefits of study participation, recruitment and consent process, data collection and data analysis.

The amount of time required for the IRB to review and approve the protocol will vary depending on such things as the IRB's procedures, the complexity of the research, the level of risk to study participants and the responsiveness of the Investigator. The average IRB approval process can last between one and three months. Once the IRB has approved the research, the awarding DoD Component will review the protocol and the IRB's determination to ensure that the research will be conducted in compliance with DoD and DoD Component policies. The DoD review process can last between three to six months. Ample time should be allotted to complete both the IRB and DoD approval processes prior to recruiting subjects. **No funding can be used towards human subject research until ALL approvals are granted. Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

4.10 Research Involving Animal Subjects

All research, development, testing, experimentation, education or training involving the use of animals shall comply with the applicable federal and agency rules on animal acquisition, transport, care, handling, and use (see Section 3).

For submissions containing animal use, proposals should briefly describe plans for their Institutional Animal Care and Use Committee (IACUC) review and approval.

All Recipients must receive their IACUC's approval as well as secondary or headquarters-level approval by a DoD veterinarian who is trained or experienced in laboratory animal medicine and science. **No animal research may be conducted using DoD funding until all the appropriate DoD office(s) grant approval. Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

4.11 Research Involving Recombinant DNA Molecules

All research involving recombinant DNA molecules shall comply with the applicable federal and state law, regulation and any additional agency guidance. Research shall be approved by an Institutional Biosafety Committee.

4.12 Debriefing/Technical Evaluation Narrative

After final award decisions have been announced, the technical evaluations of the submitter's proposal may be provided to the submitter. Please refer to the Component-specific instructions of your topics of interest for Component debriefing processes.

4.13 Pre-Award and Post Award BAA Protests

Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of this BAA must be served to:

Ms. Tara Randolph
Contracting Officer
tara.j.randolph.civ@us.navy.mil & osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil

For the purposes of a protest related to a selection or award decision, protests should be served to the point-of-contact (POC) listed in the instructions of the DoD Component that authored the topic.

For protests filed with the Government Accountability Office (GAO), a copy of the protest shall be submitted to the Contracting Officer listed above (pre-award ONLY) or DoD Component POC (selection/award decision ONLY) within one day of filing with the GAO. Protests of small business status of a selected proposing small business concern may also be made to the Small Business Administration.

4.14 Phase I Award Information

All Phase I proposals will be evaluated and judged on a competitive basis in terms of technical capability and technical value. Proposals will be initially screened to determine responsiveness to the topic objective. Proposals passing this initial screening will be technically evaluated by engineers or scientists to determine the most promising technical and scientific approaches. As a common statement of work does not exist, each proposal will be assessed on the merit of the approach in achieving the technical objectives established in the topic. DoD is under no obligation to fund any proposal or any specific number of proposals in a given topic. It also may elect to fund several or none of the proposed approaches to the same topic.

a. **Number of Phase I Awards**. The number of Phase I awards will be consistent with the Component's RDT&E budget. No Phase I contracts will be awarded until evaluation of all qualified proposals for a specific topic is completed.

b. **Type of Funding Agreement**. Each Phase I proposal selected for negotiation and possible award will be funded under negotiated contracts or purchase orders and will include a reasonable fee or profit consistent with normal profit margins provided to profit-making proposing small business concerns for R/R&D work. Firm-Fixed-Price, Firm- Fixed-Price Level of Effort, Labor Hour, Time & Material, or Cost-Plus-Fixed-Fee type contracts can be negotiated and are at the discretion of the Component Contracting Officer.

c. **Dollar Value**. The Phase I contract value varies among the DoD Components; <u>it is therefore important for proposing small business concerns to review Component-specific instructions regarding award size.</u>

d. **Timing**. Proposing small business concerns will be notified of selection or non-selection status for a Phase I award by the DoD Component that originated the topic within 90 days of the closing date for this BAA. Please refer to the Component-specific instructions for details.

   The SBA SBIR/STTR Policy Directive, Section 7(c)(1)(ii), states that agencies should issue the Phase I award no more than 180 days after the closing date of the BAA. However, across DoD, the median time between the date that the SBIR BAA closes and the award of a Phase I contract is approximately four months.

This information in this section is applicable to Phase I proposals only. If the Component is participating in the **Direct to Phase II Program**, refer to the Component-specific Direct to Phase II instructions for award information.

4.15 Questions about this BAA and BAA Topics

a. **General SBIR Questions/Information**.

AMENDMENT 2

(1) **DSIP Support**:
Email DSIP Support at DoDSBIRSupport@reisystems.com only for assistance with using the DSIP application. Questions regarding DSIP can be emailed to DSIP Support and will be addressed in the order received, during normal operating hours (Monday through Friday, 9:00 a.m. to 5:00 p.m. ET). Please include information on your small business concern, a proposal number (if applicable), and screenshots of any pertinent errors or issues encountered.

DSIP Support cannot provide updates to proposal status after submission, such as proposal selection/non-selection status or contract award status. Contact the DoD Component that originated the topic in accordance with the Component-specific instructions given at the beginning of that Component's topics.

(2) **Websites**:
The Defense SBIR/STTR Innovation Portal (DSIP) at https://www.dodsbirsttr.mil/submissions/login, which provides the following resources:

- SBIR and STTR Program Opportunities
- Topics Search Engine
- Topic Q&A
- All Electronic Proposal Submission for Phase I and Phase II Proposals. Proposing small business concerns submitting through this site for the first time will be asked to register on https://www.dodsbirsttr.mil/submissions.

DoD SBIR/STTR website at https://www.defensesbirsttr.mil/, which provides the following resources:

- Customer Support Information
- SBIR and STTR Program Opportunities
- Dates for Current and Upcoming Opportunities
- Past SBIR and STTR Program Opportunities

(3) **SBIR/STTR Updates and Notices**:
To be notified of SBIR/STTR opportunities and to receive e-mail updates on the DoD SBIR and STTR Programs, subscribe to the Listserv by selecting "DSIP Listserv" under Quick Links on the DSIP login page.

b. **General Questions about a DoD Component.** Questions pertaining to a particular DoD Component or the Component-specific BAA instructions should be submitted in accordance with the instructions given at the beginning of that Component's topics.

c. **Direct Contact with Topic Authors**. From **April 19, 2023 – May 17, 2023,** this BAA is issued for pre-release with the names of the topic authors and their phone numbers and e-mail addresses. During the pre-release period, proposing small business concerns have an opportunity to contact topic authors by telephone or e-mail to ask technical questions about specific BAA topics. Questions should be limited to specific information related to improving the understanding of a particular topic's requirements. Proposing small business concerns may not ask for advice or guidance on solution approach and you may not submit additional material to the topic author. If information provided during an exchange with the topic author is deemed necessary for proposal preparation, that information will be made available to all parties through Topic Q&A. After this period questions must be asked through Topic Q&A as described below.

d. **Topic Q&A.** Once DoD begins accepting proposals on **May 17, 2023,** no further direct contact between proposing small business concerns and topic authors is allowed unless the Topic Author is responding to a question submitted during the pre-release period. However, proposing small business concerns may submit written questions through Topic Q&A at https://www.dodsbirsttr.mil/submissions/login. In Topic Q&A, all questions and answers are posted electronically for general viewing. Identifying information for the questioner and respondent is not posted.

Questions submitted through the Topic Q&A are limited to technical information related to improving the understanding of a topic's requirements. Any other questions, such as those asking for advice or guidance on solution approach, or administrative questions, such as SBIR or STTR program eligibility, technical proposal/cost proposal structure and page count, budget and duration limitations, or proposal due date WILL NOT receive a response. Refer to the Component-specific instructions given at the beginning of that Component's topics for help with an administrative question.

Proposing small business concerns may use the Topic Search feature on DSIP to locate a topic of interest. Then, using the form at the bottom of the topic description, enter and submit the question. Answers are generally posted within seven (7) business days of question submission (answers will also be e-mailed directly to the inquirer).

The Topic Q&A for this BAA opens on **April 19, 2023**, and closes to new questions on **May 31, 2023**, **at 12:00 PM ET**. Once the BAA closes to proposal submission, no communication of any kind with the topic author or through Topic Q&A regarding your submitted proposal is allowed.

Proposing small business concerns are advised to monitor Topic Q&A during the BAA period for questions and answers. Proposing small business concerns should also frequently monitor DSIP for updates and amendments to the topics.

4.16 Registrations and Certifications

Individuals from proposing small business concerns must be registered in the Defense SBIR/STTR Innovation Portal (DSIP) in order to prepare and submit proposals. **The DSIP application is only accessible from within the United States, which is defined as the fifty states, the territories and possessions of the Federal Government, the Commonwealth of Puerto Rico, the Republic of the Marshall Islands, the Federated States of Micronesia, the Republic of Palau, and the District of Columbia.** All users are required to have an individual user account to access DSIP. As DSIP user accounts are authenticated by Login.gov, all users, who do not already have a Login.gov account, will be required to create one. If you already have a Login.gov account, you can link your existing Login.gov account with your DSIP account. Job Aids and Help Videos to walk you through the process are in the Learning & Support section of DSIP, can be accessed here: https://www.dodsbirsttr.mil/submissions/learning-support/training-materials.

Be advised that the sharing of accounts and passwords is a violation of the Terms of Use for Login.gov and DoD policy.

Please note that the email address you use for Login.gov should match the email address associated with your existing DSIP account. If you do not recall the email address associated with your DSIP account, or if you already have an existing Login.gov account using a different email address, you will need your Firm's UEI or DUNS number and your Firm PIN in order to link your Login.gov account with your DSIP account. If the email address associated with your existing DSIP account has been used for multiple DSIP accounts within your Firm, you will also need your Firm's UEI or DUNS number and your Firm PIN in order to link your Login.gov account with your DSIP account. The Firm PIN can be obtained from your Firm Admin. You can view the Firm Admin's contact information by entering your Firm's UEI or DUNS number when prompted. If you are the Firm Admin, please ensure that you contact all DSIP users in your Firm and provide them with the Firm PIN.

Users should complete their account registrations as soon as possible to avoid any delays in proposal submissions.

The System for Award Management (SAM) allows proposing small business concerns interested in conducting business with the Federal Government to provide basic information on business structure and capabilities as well as financial and payment information. Proposing small business concerns must be registered in SAM. To register, visit www.sam.gov. A proposing small business concern that is already registered in SAM should login to SAM and ensure its registration is active and its representations and certifications are up-to-date to avoid delay in award.

On April 4, 2022, the DUNS Number was replaced by the Unique Entity ID (SAM). The Federal Government will use the UEI (SAM) to identify organizations doing business with the Government. The DUNS number will no longer be a valid identifier. If the proposing small business concern has an entity registration in SAM.gov (even if the registration has expired), a UEI (SAM) has already been assigned. This can be found by signing into SAM.gov and selecting the Entity Management widget in the Workspace or by signing in and searching entity information. **For proposing small business concerns with established Defense SBIR/STTR Innovation Portal (DSIP) accounts, update the small business concern profile with the UEI (SAM) as soon as possible.**

For new proposing small business concern registrations, follow instructions during SAM registration on how to obtain a Commercial and Government Entry (CAGE) code and be assigned the UEI (SAM). Once a CAGE code and UEI (SAM) are obtained, update the proposing small business concern's profile on the DSIP at https://www.dodsbirsttr.mil/submissions/.

In addition to the standard federal and DoD procurement certifications, the SBA SBIR Policy Directive requires the collection of certain information from proposing small business concerns at time of award and during the award life cycle. Each proposing small business concern must provide this additional information at the time of the Phase I and Phase II award, prior to final payment on the Phase I award, prior to receiving 50% of the total award amount for a Phase II award, and prior to final payment on the Phase II award.

4.17 Promotional Materials

Promotional and non-project related discussion is discouraged, and additional information provided via Universal Resource Locator (URL) links or on computer disks, CDs, DVDs, video tapes or any other medium will not be accepted or considered in the proposal evaluation.

4.18 Prior, Current, or Pending Support of Similar Proposals or Awards

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work (see Section 3) for consideration under numerous federal program BAAs or solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning prior, current, or pending support of similar proposals or awards, it must be disclosed to the soliciting agency or agencies as early as possible. See Section 5.3.c(11).

AMENDMENT 2

4.19 Fraud and Fraud Reporting

Knowingly and willfully making any false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to $10,000, up to five years in prison, or both.

The Department of Defense, Office of Inspector General Hotline ("Defense Hotline") is an important avenue for reporting fraud, waste, abuse, and mismanagement within the Department of Defense. The Office of Inspector General operates this hotline to receive and investigate complaints or information from contractor employees, DoD civilians, military service members and public citizens. Individuals who wish to report fraud, waste or abuse may contact the Defense Hotline at (800) 424-9098 between 8:00 a.m. and 5:00 p.m. Eastern Time or visit https://www.dodig.mil/Components/Administrative-Investigations/DoD-Hotline/Hotline-Complaint/ to submit a complaint. Mailed correspondence should be addressed to the Defense Hotline, The Pentagon, Washington, DC 20301-1900, or e-mail addressed to hotline@dodig.mil.

4.20 State and Other Assistance Available

Many states have established programs to provide services to those proposing small business concerns and individuals wishing to participate in the Federal SBIR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to SBIR recipients;
- Assistance in obtaining Phase III funding.

Contact your State SBIR/STTR Support office at https://www.sbir.gov/state_services?state=105813# for further information. Small business concerns may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States.

4.21 Discretionary Technical and Business Assistance (TABA)

DoD has not mandated the use of TABA pending further SBA guidance and establishment of a limit on the amount of technical and business assistance services that may be received or purchased by a small business concern that has received multiple Phase II SBIR or STTR awards for a fiscal year. However, proposing small business concerns should carefully review individual component instructions to determine if TABA is being offered and follow specific proposal requirements for requesting TABA funding.

5.0 PHASE I PROPOSAL

5.1 Introduction

This BAA and the Defense SBIR/STTR Innovation Portal (DSIP) sites are designed to reduce the time and cost required to prepare a formal proposal. DSIP is the official portal for DoD SBIR/STTR proposal submission. Proposing small business concerns are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through this site for the first time will be asked to register. It is recommended that proposing small business concerns register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process.

AMENDMENT 2

This information in this section is applicable to Phase I proposals only. If the Component is participating in the **Direct to Phase II Program**, refer to the Component-specific Direct to Phase II instructions for more information on proposal preparation.

Guidance on allowable proposal content may vary by Component. A completed proposal submission in DSIP does NOT indicate that each proposal volume has been completed in accordance with the Component-specific instructions. Accordingly, it is the proposing small business concern's responsibility to consult the Component-specific instructions for detailed guidance, including required proposal documentation and structure, cost and duration limitations, budget structure, TABA allowance and proposal page limits.

DSIP provides a structure for providing the following proposal volumes:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents

a. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1) MANDATORY
b. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2) MANDATORY
c. Verification of Eligibility of Small Business Joint Ventures (Attachment 3), if applicable
d. Disclosure of Funding Sources (Attachment 4) MANDATORY
e. Other supporting documentation (Refer to Component-specific instructions for additional Volume 5 requirements)

A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.

Volume 6: Fraud, Waste and Abuse Training

All proposing small business concerns **must** complete the following:

- Volume 4: Company Commercialization Report (upload of CCR from SBIR.gov to DSIP is required for proposing small business concerns with prior Federal SBIR or STTR awards)
- Volume 5(a): Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
- Volume 5(b): Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
- Volume 5(c): Disclosure of Funding Sources (Attachment 4)
- Volume 6: Fraud, Waste and Abuse training.

Refer to Section 5.3 below for full details on these proposal requirements.

A Phase I Proposal Template is available to provide helpful guidelines for completing each section of your Phase I technical proposal. This can be found at https://www.dodsbirsttr.mil/submissions/learning-support/firm-templates.

Detailed guidance on registering in DSIP and using DSIP to submit a proposal can be found at https://www.dodsbirsttr.mil/submissions/learning-support/training-materials. If the proposal status is “In Progress” or “Ready to Certify” it will NOT be considered submitted, even if all volumes are added prior to the BAA close date. The proposing small business concern may modify all proposal volumes prior to the BAA close date.

Although signatures are not required on the electronic forms at the time of submission the proposal must be certified electronically by the corporate official for it to be considered submitted. If the proposal is selected for negotiation and possible award, the DoD Component program will contact the proposing small business concern for signatures prior to award.

5.2 Marking Proprietary Proposal Information

Proposing small business concerns that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall:

(1) Mark the first page of each Volume of the proposal submission with the following legend:

> "This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed-in whole or in part-for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this proposing small business concern as a result of-or in connection with-the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in pages [insert numbers or other identification of sheets]"; and

(2) Mark each sheet of data it wishes to restrict with the following legend:

> "Use or disclosure of data contained on this page is subject to the restriction on the first page of this volume."

The DoD assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

Restrictive notices notwithstanding, proposals and final reports submitted through the Defense SBIR/STTR Innovation Portal (DSIP) may be handled, for administrative purposes only, by support contractors. All support contractors are bound by appropriate non-disclosure agreements.

5.3 Phase I Proposal Instructions

a. Proposal Cover Sheet (Volume 1)

On the Defense SBIR/STTR Innovation Portal (DSIP) at https://www.dodsbirsttr.mil/submissions/, prepare the Proposal Cover Sheet.

The Cover Sheet must include a brief technical abstract that describes the proposed R&D project and a discussion of anticipated benefits and potential commercial applications. Each section should be no more than 200 words. **Do not include proprietary or classified information in the Proposal Cover Sheet**. If your proposal is selected for negotiation and possible award, the technical abstract and discussion of anticipated benefits may be publicly released on the Internet. Once the Cover Sheet is saved, the system will assign a proposal number. You may modify the cover sheet as often as necessary until the BAA closes.

Effective January 2023, the amounts listed in the Percentage of Work (POW) certification question on the Proposal Cover Sheet are derived from information entered by the proposing small business concern in the Cost Volume (Volume 3). Details on the calculation can be viewed in DSIP during proposal submission.

If the POW calculations fall below eligibility requirements, a letter of explanation or approval by the Funding Agreement officer must be uploaded to the certification question to complete the submission. Some DoD Components will not accept any deviations from the POW minimum requirements. Please refer to the Component instructions regarding acceptance of deviations to the POW requirements.

b. **Format of Technical Volume (Volume 2)**

(1) **Type of file**: The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. **Do not lock or encrypt the uploaded file. Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document.**

(2) **Length**: It is the proposing small business concern's responsibility to verify that the Technical Volume does not exceed the page limit after upload to DSIP. Please refer to Component-specific instructions for how a technical volume is handled if the stated page count is exceeded. Some Components will reject the entire technical proposal if the proposal exceeds the stated page count.

(3) **Layout:** Number all pages of your proposal consecutively. Those who wish to respond must submit a direct, concise, and informative research or research and development proposal (no type smaller than 10-point on standard 8-1/2" x 11" paper with one-inch margins). The header on each page of the Technical Volume should contain your proposing small business concern name, topic number, and proposal number assigned by the Defense SBIR/STTR Innovation Portal (DSIP) when the Cover Sheet was created. The header may be included in the one-inch margin.

c. **Content of the Technical Volume (Volume 2)**

The Technical Volume should cover the following items in the order given below:

(1) **Identification and Significance of the Problem or Opportunity.** Define the specific technical problem or opportunity addressed and its importance.

(2) **Phase I Technical Objectives.** Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(3) **Phase I Statement of Work (including Subcontractors' Efforts)**

a. Provide an explicit, detailed description of the Phase I approach. If a Phase I option is required or allowed by the Component, describe appropriate research activities which would commence at the end of Phase I base period should the Component elect to exercise the option. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

b. This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained (see Sections 4.9 - 4.11). **Small Business Concerns proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(4) **Related Work.** Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing small business concern, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposing small business concern's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:

a. Short description,
b. Client for which work was performed (including individual to be contacted and phone number), and
c. Date of completion.

(5) **Relationship with Future Research or Research and Development**

a. State the anticipated results of the proposed approach if the project is successful.
b. Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.
c. Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(6) **Commercialization Strategy.** Describe in approximately one page your proposing small business concern's strategy for commercializing this technology in DoD, other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your proposing small business concern expects to achieve.

(7) **Key Personnel.** Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limitations for Volume 2.

(8) **Foreign Citizens.** Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant.

For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposing small business concerns frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal may be deemed nonresponsive if the requested information is not provided. Therefore, proposing small business concerns should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in Section 3 of the BAA. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

(9) **Facilities/Equipment.** Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(10) **Subcontractors/Consultants.** Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two- thirds of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing small business concern, unless otherwise approved in writing by the Contracting Officer. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposing small business concerns must certify their use of such facilities on the Cover Sheet of the proposal.

(11) **Prior, Current, or Pending Support of Similar Proposals or Awards.** If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information:

a. Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
b. Date of proposal submission or date of award.
c. Title of proposal.
d. Name and title of principal investigator for each proposal submitted or award received.
e. Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
f. If award was received, state contract number.
g. Specify the applicable topics for each SBIR proposal submitted or award received.

Note: If this does not apply, state in the proposal "No prior, current, or pending support for proposed work."

d. **Content of the Cost Volume (Volume 3)**

Complete the Cost Volume by using the on-line cost volume form on the Defense SBIR/STTR Innovation Portal (DSIP). Some items in the cost breakdown may not apply to the proposed project. If that is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow us to understand how you plan to use the requested funds if a contract is awarded.

(1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.

(2) While special tooling and test equipment and material cost may be included under Phases I, the inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Component Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.

(3) Cost for travel funds must be justified and related to the needs of the project.

(4) Cost sharing is permitted for proposals under this BAA; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a Phase I proposal.

(5) A Phase I Option (if applicable) should be fully costed separately from the Phase I (base) approach.

(6) All subcontractor costs and consultant costs, such as labor, travel, equipment, materials, must be detailed at the same level as prime contractor costs. Provide detailed substantiation of subcontractor costs in your cost proposal. Volume 5, Supporting Documents, may be used if additional space is needed.

When a proposal is selected for negotiation and possible award, you must be prepared to submit further documentation to the Component Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors). For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit-Process-Overview/.

e. **Company Commercialization Report (Volume 4)**

The Company Commercialization Report (CCR) allows companies to report funding outcomes resulting from prior SBIR and STTR awards. SBIR and STTR awardees are required by SBA to update and maintain their organization's CCR on SBIR.gov. Commercialization information is required upon completion of the last deliverable under the funding agreement. Thereafter, SBIR and STTR awardees are requested to voluntarily update the information in the database annually for a minimum period of 5 years.

If the proposing small business concern has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, regardless of whether the project has any commercialization to date, a

PDF of the CCR must be downloaded from SBIR.gov and uploaded to the Firm Forms section of DSIP by the Firm Admin. Firm Forms are completed by the DSIP Firm Admin and are applied across all proposals the proposing small business concern submits. The DSIP CCR requirement is fulfilled by completing the following:

1. Log into the firm account at https://www.sbir.gov/.
2. Navigate to My Dashboard > My Documents to view or print the information currently contained in the Company Registry Commercialization Report.
3. Create or update the commercialization record, from the company dashboard, by scrolling to the “My Commercialization” section, and clicking the create/update Commercialization tab under “Current Report Version”. Please refer to the “Instructions” and “Guide” documents contained in this section of the Dashboard for more detail on completing and updating the CCR. **Ensure the report is certified and submitted.**
4. Click the “Company Commercialization Report” PDF under the My Documents section of the dashboard to download a PDF of the CCR.
5. Upload the PDF of the CCR (downloaded from SBIR.gov in previous step) to the Company Commercialization Report in the Firm Forms section of DSIP. This upload action must be completed by the Firm Admin.

This version of the CCR, uploaded to DSIP from SBIR.gov, is inserted into all proposal submissions as Volume 4.
During proposal submission, the proposing small business concern will be prompted with the question: “Do you have a new or revised Company Commercialization Report to upload?”. There are three possible courses of action:

a. If the proposing small business concern has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, and **DOES have a new or revised CCR from SBIR.gov to upload to DSIP**, select YES.
   - If the user is the Firm Admin, they can upload the PDF of the CCR from SBIR.gov directly on this page. It will also be updated in the Firm Forms and be associated with all new or in-progress proposals submitted by the proposing small business concern. If the user is not the Firm Admin, they will receive a message that they do not have access and must contact the Firm Admin to complete this action.
   - **WARNING:** Uploading a new CCR under the Firm Forms section of DSIP or clicking “Save” or “Submit” in Volume 4 of one proposal submission is considered a change for ALL proposals under any open BAAs or CSOs. If a proposing small business concern has previously certified and submitted any Phase I or Direct to Phase II proposals under ***any*** BAA or CSO ***that is still open***, those proposals will be automatically reopened. Proposing small business concerns will have to recertify and resubmit such proposals. If a proposing small business concern does not recertify or resubmit such proposals, they will not be considered fully submitted and will not be evaluated.

b. If the proposing small business concern has prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, and **DOES NOT have a new or revised CCR from SBIR.gov to upload to DSIP**, select NO.
   - If a prior CCR was uploaded to the Firm Forms, the proposing small business concern will see a file dialog box at the bottom of the page and can view the previously uploaded CCR. This read-only access allows the proposing small business concern to confirm that the CCR has been uploaded by the Firm Admin.

- If no file dialog box is present at the bottom of the page that is an indication that **there is no previously uploaded CCR in the DSIP Firm Forms**. To fulfill the DSIP CCR requirement the Firm Admin must follow steps 1-5 listed above to download a PDF of the CCR from SBIR.gov and upload it to the DSIP Firm Forms to be included with all proposal submissions.

c. If the proposing small business concern has **NO** prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards, the upload of the CCR from SBIR.gov is not required and small business concern will select NO. The CCR section of the proposal will be marked complete.

While all proposing small business concerns with prior DoD and/or non-DoD Phase I and/or Phase II SBIR/STTR awards must report funding outcomes resulting from these awards through the CCR from SBIR.gov and upload a copy of this report to their Firm Forms in DSIP, **please refer to the Component-specific instructions for details on how this information will be considered during proposal evaluations.**

f. **Supporting Documents (Volume 5)**

Volume 5 is provided for proposing small business concerns to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3).

All proposing small business concerns are REQUIRED to submit the following documents to Volume 5:

1. Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (Attachment 1)
2. Disclosures of Foreign Affiliations or Relationships to Foreign Countries (Attachment 2)
3. Disclosure of Funding Sources (Attachment 4)

A completed proposal submission in DSIP does NOT indicate that the mandatory supporting documents have been uploaded. It is the responsibility of the proposing small business concern to ensure that the mandatory documents listed above have been uploaded and included with the proposal submission.

Any of the following documents may be included in Volume 5 if applicable to the proposal. Refer to Component-specific instructions for additional Volume 5 requirements.

1. Letters of Support
2. Additional Cost Information
3. Funding Agreement Certification
4. Technical Data Rights (Assertions)
5. Lifecycle Certification
6. Allocation of Rights
7. Verification of Eligibility of Small Business Joint Ventures (Attachment 3)
8. Other

g. **Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment**

The DoD must comply with Section 889(a)(1)(B) of the National Defense Authorization Act (NDAA) for Fiscal Year 2019, and is working to reduce or eliminate contracts with entities that use any equipment, system, or service that uses covered telecommunications equipment or services (as defined in BAA Attachment 1) as a substantial or essential component of any system, or as critical technology as part of any system.

All proposals must include certifications in Defense Federal Acquisition Regulation Supplement (DFARS) provisions 252.204-7016, 252.204-7017, and clause 252.204-7018, executed by the proposing small business concern's authorized proposing small business concern representative. The DFARS provisions and clause may be found in BAA Attachment 1. **These certifications must be signed by the authorized proposing small business concern representative and uploaded as a separate PDF file in the supporting documents sections of Volume 5 for all proposal submissions.**

The effort to complete the required certification clauses includes the proposing small business concern and any contractors that may be proposed as a part of the submission including research partners and suppliers. Therefore, proposing small business concerns are strongly encouraged to review the requirements of these certifications early in the proposal development process. Failure to submit or complete the required certifications as a part of the proposal submission process may be cause for rejection of the proposal submission without evaluation.

h. **Disclosures of Foreign Affiliations or Relationships to Foreign Countries**

In accordance with Section 4 of the SBIR and STTR Extension Act of 2022 and the SBA SBIR/STTR Policy Directive, the Department of Defense will review all proposals submitted in response to this BAA to assess security risks presented by small business concerns seeking a Federally funded award. **Proposing small business concerns must complete Attachment 2: Disclosures of Foreign Affiliations or Relationships to Foreign Countries and upload to Volume 5**. **Proposals that do not include Attachment 2 in Volume 5 will be deemed noncompliant and will not receive an evaluation.** For additional details, please refer to Section 2.2 and 4.3.

i. **Certification Regarding Disclosure of Funding Sources**

The proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, which requires that covered individuals:

(A) disclose the amount, type, and source of all current and pending research support received by, or expected to be received by, the individual as of the time of the disclosure;
(B) certify that the disclosure is current, accurate, and complete; and
(C) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award

Small business concerns must also certify that each covered individual who is employed by the small business and listed on the proposal has been made aware of the requirements listed above. **The disclosure and certification must be made by completing Attachment 4 of this**

BAA and uploading to Volume 5, Supporting Documents of the proposal submission in DSIP, utilizing the "Other" category for document type.

j. **Fraud, Waste and Abuse Training (Volume 6)**

The Fraud, Waste and Abuse (FWA) training is **required** for Phase I and Direct to Phase II proposals. FWA training provides information on what represents FWA in the SBIR/STTR program, the most common mistakes that lead to FWA, as well as the penalties and ways to prevent FWA in your small business concern. This training material can be found in the Volume 6 section of the proposal submission module in DSIP and must be thoroughly reviewed once per year. Plan ahead and leave ample time to complete this training based on the proposal submission deadline. FWA training must be completed by one DSIP firm user with read/write access (Proposal Owner, Corporate Official or Firm Admin) on behalf of the proposing small business concern.

6.0 PHASE I EVALUATION CRITERIA

Proposals will be evaluated based on the criteria outlined below, unless otherwise specified in the Component-specific instructions. Selections will be based on a determination of the overall technical value of each proposal and an evaluation of the cost volume, with the appropriate method of analysis given the contract type to be awarded, in order for selection of the proposal(s) most advantageous to the Government, considering the following factors which are listed in descending order of importance:

a. The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b. The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c. The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

Cost or budget data submitted with the proposals will be considered during evaluation.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the proposing small business concern or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be included based on requirements provided in Component-specific instructions.

Denial of Awards

The DoD will not make an award under the SBIR program if it determines that—

(A) the small business concern submitting the proposal –
- (i) has an owner or covered individual that is party to a malign foreign talent recruitment program;
- (ii) has a business entity, parent company, or subsidiary located in the People's Republic of China or another foreign country of concern; or
- (iii) has an owner or covered individual that has a foreign affiliation with a foreign entity located in the People's Republic of China or another foreign country of concern; and

(B) the relationships and commitments described in clauses (i) through (iii) of subparagraph (A)—
- (i) interfere with the capacity for activities supported by the DoD to be carried out;
- (ii) create duplication with activities supported by the DoD;

(iii) present concerns about conflicts of interest;
(iv) were not appropriately disclosed to the DoD;
(v) violate Federal law or terms and conditions of contracts or other agreements awarded by the DoD; or
(vi) pose a risk to national security.

7.0 PHASE II PROPOSAL INFORMATION

7.1 Introduction

Unless the Component is participating in Direct to Phase II, Phase II proposals may only be submitted by Phase I awardees. Submission of Phase II proposals are not permitted at this time, and if submitted, may be rejected without evaluation. Phase II proposal preparation and submission instructions will be provided by the DoD Components to Phase I awardees. See Component-specific instructions for more information on Direct to Phase II Program preparation and submission instructions.

7.2 Proposal Provisions

IMPORTANT -- While it is permissible, with proposal notification, to submit identical proposals or proposals containing a significant amount of essentially equivalent work for consideration under numerous federal program BAAs and solicitations, it is unlawful to enter into contracts or grants requiring essentially equivalent effort. If there is any question concerning this, it must be disclosed to the soliciting agency or agencies as early as possible. If a proposal submitted for a Phase II effort is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Cover Sheet and provide the information required in Section 5.4.c(11).

Due to specific limitations on the amount of funding and number of awards that may be awarded to a particular proposing small business concern per topic using SBIR/STTR program funds, Head of Agency Determinations are now required before a different agency may make an award using another agency's topic. This limitation does not apply to Phase III funding. Please contact your original sponsoring agency before submitting a Phase II proposal to an agency other than the one who sponsored the original topic.

Section 4(b)(1)(i) of the SBIR/STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a solicitation for SBIR may transition in Phase II to STTR and vice versa. A proposing small business concern wishing to transfer from one program to another must contact their designated technical monitor to discuss the reasons for the request and the agency's ability to support the request. The transition may be proposed prior to award or during the performance of the Phase II effort. Agency disapproval of a request to change programs shall not be grounds for granting relief from any contractual performance requirement. All approved transitions between programs must be noted in the Phase II award or award modification signed by the contracting officer that indicates the removal or addition of the research institution and the revised percentage of work requirements.

7.3 Commercialization Strategy

At a minimum, your commercialization strategy must address the following five questions:
(1) What is the first product that this technology will go into?
(2) Who will be the customers, and what is the estimated market size?
(3) How much money will be needed to bring the technology to market, and how will that money be raised?

(4) Does the proposing small business concern contain marketing expertise and, if not, how will that expertise be brought into the small business concern?
(5) Who are the proposing small business concern's competitors, and what is the price and/or quality advantage over those competitors?

The commercialization strategy must also include a schedule showing the anticipated quantitative commercialization results from the Phase II project at one year after the start of Phase II, at the completion of Phase II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc.). After Phase II award, the proposing small business concern is required to report actual sales and investment data in its SBA Company Commercialization Report via "My Dashboard" on SBIR.gov at least annually. For information on formatting, page count and other details, please refer to the Component-specific instructions.

7.4 Phase II Evaluation Criteria

Phase II proposals will be evaluated based on the criteria outlined above in section 6.0, unless otherwise specified in the Component-specific instructions.

7.5 Phase II Award Information

DoD Components will notify Phase I awardees of the Phase II proposal submission requirements. Submission of Phase II proposals will be in accordance with instructions provided by individual Components. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the awarding DoD Component either in the Phase I award or by subsequent notification.

7.6 Adequate Accounting System

In order to reduce risk to the small business and avoid potential contracting delays, it is suggested that companies interested in pursuing Phase II SBIR contracts and other contracts of similar size with the Department of Defense (DoD), have an adequate accounting system per General Accepted Accounting Principles (GAAP), Generally Accepted Government Auditing Standards (GAGAS), Federal Acquisition Regulation (FAR) and Cost Accounting Standards (CAS) in place. The accounting system will be audited by the Defense Contract Audit Agency (DCAA). DCAA's requirements and standards are available on their Website at https://www.dcaa.mil/Guidance/Audit-Process-Overview/ and https://www.dcaa.mil/Checklists-Tools/Pre-award-Accounting-System-Adequacy-Checklist/.

7.7 Phase II Enhancement Policy

To further encourage the transition of SBIR research into DoD acquisition programs as well as the private sector, certain DoD Components have developed their own Phase II Enhancement policy. Under this policy, the Component will provide a Phase II awardee with additional Phase II SBIR funding if the proposing small business concern can match the additional SBIR funds with non-SBIR funds from DoD acquisition programs or the private sector.

See component instructions for more details on Phase II Enhancement opportunities.

7.8 Commercialization Readiness Program (CRP)

The SBIR/STTR Reauthorization Act of 2011 established the Commercialization Pilot Program (CPP) as a long-term program titled the Commercialization Readiness Program (CRP).

AMENDMENT 2

Each Military Department (Army, Navy, and Air Force) has established a Commercialization Readiness Program. Please check the Component instructions for further information.

The DoD SBIR/STTR Program has established the OSD Transitions SBIR Technology (OTST) Pilot Program. The OTST pilot program is an interim technology maturity phase (Phase II), inserted into the SBIR development.

For more information contact osd.ncr.ousd-r-e.mbx.sbir-sttr-tech-transition@mail.mil.

8.0 CONTRACTUAL REQUIREMENTS

8.1 Additional Contract Requirements

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of Government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulation that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

Examples of general provisions:

a. **Standards of Work**. Work performed under the contract must conform to high professional standards.
b. **Inspection**. Work performed under the contract is subject to Government inspection and evaluation at all reasonable times.
c. **Examination of Records**. The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.
d. **Default**. The Government may terminate the contract if the contractor fails to perform the work contracted.
e. **Termination for Convenience**. The contract may be terminated at any time by the Government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.
f. **Disputes**. Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.
g. **Contract Work Hours**. The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).
h. **Equal Opportunity**. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
i. **Affirmative Action for Veterans**. The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran.
j. **Affirmative Action for Handicapped**. The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.
k. **Officials Not to Benefit**. No member of or delegate to Congress shall benefit from the contract.
l. **Covenant Against Contingent Fees**. No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.

m. **Gratuities**. The contract may be terminated by the Government if any gratuities have been offered to any representative of the Government to secure the contract.
n. **Patent Infringement**. The contractor shall report each notice or claim of patent infringement based on the performance of the contract.
o. **Military Security Requirements**. The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.
p. **American Made Equipment and Products**. When purchasing equipment or a product under the SBIR funding agreement, purchase only American-made items whenever possible.

Applicable Federal Acquisition Regulation (FAR) and/or Defense Federal Acquisition Regulation Supplement (DFARS) Clauses:

q. **Unique Identification (UID)**. If your proposal identifies hardware that will be delivered to the government, be aware of the possible requirement for unique item identification in accordance with DFARS 252.211-7003.
r. **Disclosure of Information.** In accordance with FAR 252.204-7000, Government review and approval will be required prior to any dissemination or publication, regardless of medium (e.g., film, tape, document), pertaining to any part of this contract or any program related to this contract except within and between the Contractor and any subcontractors, of unclassified and non-fundamental information developed under this contract or contained in the reports to be furnished pursuant to this contract.
s. **Animal Welfare**. Contracts involving research, development, test, evaluation, or training on vertebrate animals will incorporate DFARS clause 252.235-7002.
t. **Protection of Human Subjects**. Effective 29 July 2009, contracts that include or may include research involving human subjects in accordance with 32 CFR Part 219, DoD Directive 3216.02 and 10 U.S.C. 980, including research that meets exemption criteria under 32 CFR 219.101(b), will incorporate DFARS clause 252.235-7004.
u. **E-Verify**. Contracts exceeding the simplified acquisition threshold may include the FAR clause 52.222-54 "Employment Eligibility Verification" unless exempted by the conditions listed at FAR 22.2803.
v. **ITAR**. In accordance with DFARS 225.7901-4, Export Control Contract Clauses, the clause found at DFARS 252.225-7048, Export-Controlled Items (June 2013), must be included in all BAAs/solicitations and contracts. Therefore, all awards resulting from this BAA will include DFARS 252.225-7048. Full text of the clause may be found at https://www.govinfo.gov/content/pkg/CFR-2013-title48-vol3/pdf/CFR-2013-title48-vol3-sec252-225-7048.pdf.
w. **Cybersecurity**. Any small business concern receiving an SBIR/STTR award is required to provide adequate cybersecurity on all covered contractor information systems. Specific security requirements and cyber incident reporting requirements are listed in DFARS 252.204.7012. To learn about cybersecurity resources for your SBIR/STTR contract visit the Blue Cyber webpage: https://www.safcn.af.mil/CISO/Small-Business-Cybersecurity-Information/.
x. **Safeguarding Covered Defense Information Controls.** As prescribed in DFARS 252.204-7008, for covered contractor information systems that are not part of an information technology service or system operated on behalf of the Government, the SBC represents that it will implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, "Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations."
y. **Limitations on the Use or Disclosure of Third- Party Contractor Reported Cyber Incident Information.** As required in DFARS 252.204-7009, the Contractor must agree that certain conditions apply to any information it receives or creates in the performance of a resulting contract that is information obtained from a third-party's reporting of a cyber incident pursuant

to DFARS clause 252.204-7012, Safeguarding Covered Defense Information and Cyber Incident Reporting (or derived from such information obtained under that clause).

z. **Notice of NIST SP 800-171 DoD Assessment Requirements.** As prescribed by DFARS 252.204-7019, in order to be considered for award, the SBC is required to implement NIST SP 800-171. The SBC shall have a current assessment (see 252.204-7020) for each covered contractor information system that is relevant to the offer, contract, task order, or delivery order. The Basic, Medium, and High NIST SP 800-171 DoD Assessments are described in the NIST SP 800-171 DoD Assessment Methodology located at https://www.acq.osd.mil/dpap/pdi/cyber/strategically_assessing_contractor_implementation_of_NIST_SP_800-171.html. In accordance with DFARS 252.204-7020, the SBC shall provide access to its facilities, systems, and personnel necessary for the Government to conduct a Medium or High NIST SP 800-171 DoD Assessment, as described in NIST SP 800-171 DoD Assessment Methodology, linked above. Notification of specific requirements for NIST SP 800-171 DoD assessments and assessment level will be provided as part of the component instructions, topic, or award.

aa. **Contractor Certification Regarding Provision of Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment.** In accordance with DFARS Subpart 204.21, DFARS provisions 252.204-7016, 252.204-7017, and clause 252.204-7018 are incorporated into this solicitation. This subpart implements section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) and section 889(a)(1)(A) of the National Defense Authorization Act for Fiscal Year 2019 (Pub. L. 115-232). Full text of the provisions and clause and required offeror representations can be found in Attachment 1 of this BAA.

8.2 Agency Recovery Authority and Ongoing Reporting

In accordance with Section 5 of the SBIR and STTR Extension Act of 2022, the DoD will –

1) require a small business concern receiving an award under its SBIR program to repay all amounts received from the Federal agency under the award if—
    (A) the small business concern makes a material misstatement that the Federal agency determines poses a risk to national security; or
    (B) there is a change in ownership, change to entity structure, or other substantial change in circumstances of the small business concern that the Federal agency determines poses a risk to national security; and
2) require a small business concern receiving an award under its SBIR program to regularly report to the Federal agency and the Administration throughout the duration of the award on—
    (A) any change to a disclosure required under subparagraphs (A) through (G) of section 4.3 above;
    (B) any material misstatement made under section 8.2 paragraph (A) above; and
    (C) any change described in section 8.2 paragraph (B) above.

8.3 Basic Safeguarding of Covered Contractor Information Systems

FAR 52.204-21, Basic Safeguarding of Covered Contractor Information Systems, is incorporated into this solicitation. In accordance with FAR 52.204-21, the contractor shall apply basic safeguarding requirements and procedures when the contractor or a subcontractor at any tier may have Federal contract information residing in or transiting through its information system.

FAR 52.204-21 Basic Safeguarding of Covered Contractor Information Systems (NOV 2021)

(a) **Definitions.** As used in this clause -

(1) *Covered contractor information system* means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.

(2) *Federal contract information* means information, not intended for public release, that is provided by or generated for the Government under a contract to develop or deliver a product or service to the Government, but not including information provided by the Government to the public (such as on public websites) or simple transactional information, such as necessary to process payments.

(3) *Information* means any communication or representation of knowledge such as facts, data, or opinions, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual (Committee on National Security Systems Instruction (CNSSI) 4009).

(4) *Information system* means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information (44 U.S.C. 3502).

(5) *Safeguarding* means measures or controls that are prescribed to protect information systems.

(b) Safeguarding requirements and procedures.

(1) The Contractor shall apply the following basic safeguarding requirements and procedures to protect covered contractor information systems. Requirements and procedures for basic safeguarding of covered contractor information systems shall include, at a minimum, the following security controls:

(i) Limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems).

(ii) Limit information system access to the types of transactions and functions that authorized users are permitted to execute.

(iii) Verify and control/limit connections to and use of external information systems.

(iv) Control information posted or processed on publicly accessible information systems.

(v) Identify information system users, processes acting on behalf of users, or devices.

(vi) Authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems.

(vii) Sanitize or destroy information system media containing Federal Contract Information before disposal or release for reuse.

(viii) Limit physical access to organizational information systems, equipment, and the respective operating environments to authorized individuals.

(ix) Escort visitors and monitor visitor activity; maintain audit logs of physical access; and control and manage physical access devices.

(x) Monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems.

(xi) Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.

(xii) Identify, report, and correct information and information system flaws in a timely manner.

(xiii) Provide protection from malicious code at appropriate locations within organizational information systems.

(xiv) Update malicious code protection mechanisms when new releases are available.

(xv) Perform periodic scans of the information system and real-time scans of files from external sources as files are downloaded, opened, or executed.

(2) Other requirements. This clause does not relieve the Contractor of any other specific safeguarding requirements specified by Federal agencies and departments relating to covered contractor information systems generally or other Federal safeguarding requirements for controlled unclassified information (CUI) as established by Executive Order 13556.

(c) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (c), in subcontracts under this contract (including subcontracts for the acquisition of commercial products or commercial services, other than commercially available off-the-shelf items), in which the subcontractor may have Federal contract information residing in or transiting through its information system.

(End of clause)

8.4 Prohibition on Contracting with Persons that have Business Operations with the Maduro Regime

DFARS 252.225-7055, Representation Regarding Business Operations with the Maduro Regime, is incorporated into this solicitation. In accordance with section 890 of the National Defense Authorization Act for Fiscal Year 2020 (Pub. L. 116-92), DoD is prohibited from entering into a contract for the procurement of products or services with any person that has business operations with an authority of the government of Venezuela that is not recognized as the legitimate government of Venezuela by the United States Government, unless the person has a valid license to operate in Venezuela issued by the Office of Foreign Assets Control of the Department of the Treasury.

8.5 Copyrights

With prior written permission of the Contracting Officer, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgment and disclaimer statement.

AMENDMENT 2

8.6 Patents

Small business concerns normally may retain the principal worldwide patent rights to any invention developed with Government support. The Government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 U.S.C. § 205, the Government will not make public any information disclosing a Government-supported invention for a period of five years to allow the awardee to pursue a patent. See also Section 8.7, Invention Reporting.

8.7 Invention Reporting

SBIR awardees must report inventions to the Component within two months of the inventor's report to the awardee. The reporting of inventions may be accomplished by submitting paper documentation, including fax, or through the Edison Invention Reporting System at www.iedison.gov for those agencies participating in iEdison.

8.8 Technical Data Rights

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this BAA generally remain with the contractor, except that the Government obtains a royalty-free license to use such technical data only for Government purposes during the period commencing with contract award and ending twenty years after completion of the project under which the data were generated. This data should be marked with the restrictive legend specified in DFARS 252.227-7018 Class Deviation 2020-O0007. Upon expiration of the twenty-year restrictive license, the Government has Government Purpose Rights in the SBIR data. During the license period, the Government may not release or disclose SBIR data to any person other than its support services contractors except: (1) For evaluation purposes; (2) As expressly permitted by the contractor; or (3) A use, release, or disclosure that is necessary for emergency repair or overhaul of items operated by the Government. See DFARS clause 252.227-7018 Class Deviation 2020-O0007 "Rights in Noncommercial Technical Data and Computer Software – Small Business Innovation Research (SBIR) Program."

If a proposing small business concern plans to submit assertions in accordance with DFARS 252.227-7017 Class Deviation 2020-O0007, those assertions must be identified and assertion of use, release, or disclosure restriction MUST be included with your proposal submission, at the end of the technical volume. The contract cannot be awarded until assertions have been approved.

8.9 Final Technical Reports - Phase I through Phase III

a. **Content**: A final report is required for each project phase. The reports must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page," will be used as the first page of the report. Submission resources are available at https://discover.dtic.mil/submit-documents/. In addition, monthly status and progress reports may be required by the DoD Component.

b. **SF 298 Form "Report Documentation Page" Preparation**:
   (1) If desirable, language used by the proposing small business concern in its Phase II proposal to report Phase I progress may also be used in the final report.

(2) For each unclassified report, the proposing small business concern submitting the report should fill in Block 12 (Distribution/Availability Statement) of the SF 298, "Report Documentation Page," with the following statement: "Distribution authorized to U.S. Government only; Proprietary Information, (Date of Determination). Other requests for this document shall be referred to the Component SBIR Program Office."

Note: Data developed under a SBIR contract is subject to SBIR Data Rights which allow for protection under DFARS 252.227-7018 Class Deviation 2020-O0007 (see Section 8.5, Technical Data Rights). The sponsoring DoD activity, after reviewing the proposing small business concern's entry in Block 12, has final responsibility for assigning a distribution statement.

For additional information on distribution statements see the following Defense Technical Information Center (DTIC) Web site: https://discover.dtic.mil/wp-content/uploads/2018/09/distribution_statements_and_reasonsSept2018.pdf

(3) Block 14 (Abstract) of the SF 298, "Report Documentation Page" must include as the first sentence, "Report developed under SBIR contract for topic [insert BAA topic number. [Follow with the topic title, if possible.]" The abstract must identify the purpose of the work and briefly describe the work conducted, the findings or results and the potential applications of the effort. **Since the abstract will be published by the DoD, it must not contain any proprietary or classified data and type "UU" in Block 17.**

(4) Block 15 (Subject Terms) of the SF 298 must include the term "SBIR Report".

c. **Submission**: In accordance with DoD Directive 3200.12 and DFARS clause 252.235-7011, a copy of the final report shall be submitted (electronically or on disc) to:

Defense Technical Information Center
ATTN: DTIC-OA (SBIR)
8725 John J Kingman Road, Suite 0944
Ft. Belvoir, VA 22060-6218

Delivery will normally be within 30 days after completion of the Phase I technical effort.

Other requirements regarding submission of reports and/or other deliverables will be defined in the Contract Data Requirements List (CDRL) of each contract. Special instructions for the submission of CLASSIFIED reports will be defined in the delivery schedule of the contract.

DO NOT E-MAIL Classified or controlled unclassified reports, or reports containing SBIR Data Rights protected under DFARS 252.227-7018 Class Deviation 2020-O0007.

AMENDMENT 2

ATTACHMENT 1

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

CONTRACTOR CERTIFICATION REGARDING PROVISION OF PROHIBITION ON CONTRACTING FOR CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT (DFARS SUBPART 204.21)

Contractor's Name	
Small Business Concern Name	
Office Tel #	
Mobile #	
Email	

Name of person authorized to sign: ____

Signature of person authorized: ____

Date: ____________________________

The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

DFARS PROVISIONS INCORPORATED IN FULL TEXT:

252.204-7016 Covered Defense Telecommunications Equipment or Services—Representation

COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES—REPRESENTATION (DEC 2019)

(a) *Definitions*. As used in this provision, "covered defense telecommunications equipment or services" has the meaning provided in the clause 252.204-7018 , Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services.

(b) *Procedures*. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) (https://www.sam.gov/) for entities excluded from receiving federal awards for "covered defense telecommunications equipment or services".

(c) *Representation*. The Offeror represents that it ☐ does, ☐ does not provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument.

252.204-7017 Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services—Representation

PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES—REPRESENTATION (MAY 2021)

*The Offeror is not required to complete the representation in this provision if the Offeror has represented in the provision at 252.204-7016 , Covered Defense Telecommunications Equipment or Services—Representation, that it "**does not** provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument."*

(a) *Definitions*. "Covered defense telecommunications equipment or services," "covered mission," "critical technology," and "substantial or essential component," as used in this provision, have the meanings given in the 252.204-7018 clause, Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services, of this solicitation.

(b) *Prohibition*. Section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91) prohibits agencies from procuring or obtaining, or extending or renewing a contract to procure or obtain, any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

(c) *Procedures*. The Offeror shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

Representation. If in its annual representations and certifications in SAM the Offeror has represented in paragraph (c) of the provision at 252.204-7016 , Covered Defense Telecommunications Equipment or Services—Representation, that it "does" provide covered defense telecommunications equipment or services as a part of its offered products or services to the Government in the performance of any contract, subcontract, or other contractual instrument, then the Offeror shall complete the following additional representation:

The Offeror represents that it ☐will ☐will not provide covered defense telecommunications equipment or services as a part of its offered products or services to DoD in the performance of any award resulting from this solicitation.

(e) *Disclosures*. If the Offeror has represented in paragraph (d) of this provision that it “will provide covered defense telecommunications equipment or services,” the Offeror shall provide the following information as part of the offer:

(1) A description of all covered defense telecommunications equipment and services offered (include brand or manufacturer; product, such as model number, original equipment manufacturer (OEM) number, manufacturer part number, or wholesaler number; and item description, as applicable).

(2) An explanation of the proposed use of covered defense telecommunications equipment and services and any factors relevant to determining if such use would be permissible under the prohibition referenced in paragraph (b) of this provision.

(3) For services, the entity providing the covered defense telecommunications services (include entity name, unique entity identifier, and Commercial and Government Entity (CAGE) code, if known).

(4) For equipment, the entity that produced or provided the covered defense telecommunications equipment (include entity name, unique entity identifier, CAGE code, and whether the entity was the OEM or a distributor, if known).

(End of provision)

252.204-7018 Prohibition on the Acquisition of Covered Defense Telecommunications Equipment or Services

PROHIBITION ON THE ACQUISITION OF COVERED DEFENSE TELECOMMUNICATIONS EQUIPMENT OR SERVICES (JAN 2021)

Definitions. As used in this clause—

“Covered defense telecommunications equipment or services” means—

(1) Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation, or any subsidiary or affiliate of such entities;

(2) Telecommunications services provided by such entities or using such equipment; or

(3) Telecommunications equipment or services produced or provided by an entity that the Secretary of Defense reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

AMENDMENT 2

"Covered foreign country" means—

(1) The People's Republic of China; or

(2) The Russian Federation.

"Covered missions" means—

(1) The nuclear deterrence mission of DoD, including with respect to nuclear command, control, and communications, integrated tactical warning and attack assessment, and continuity of Government; or

(2) The homeland defense mission of DoD, including with respect to ballistic missile defense.

"Critical technology" means—

(1) Defense articles or defense services included on the United States Munitions List set forth in the International Traffic in Arms Regulations under subchapter M of chapter I of title 22, Code of Federal Regulations;

(2) Items included on the Commerce Control List set forth in Supplement No. 1 to part 774 of the Export Administration Regulations under subchapter C of chapter VII of title 15, Code of Federal Regulations, and controlled—

(i) Pursuant to multilateral regimes, including for reasons relating to national security, chemical and biological weapons proliferation, nuclear nonproliferation, or missile technology; or

(ii) For reasons relating to regional stability or surreptitious listening;

(3) Specially designed and prepared nuclear equipment, parts and components, materials, software, and technology covered by part 810 of title 10, Code of Federal Regulations (relating to assistance to foreign atomic energy activities);

(4) Nuclear facilities, equipment, and material covered by part 110 of title 10, Code of Federal Regulations (relating to export and import of nuclear equipment and material);

(5) Select agents and toxins covered by part 331 of title 7, Code of Federal Regulations, part 121 of title 9 of such Code, or part 73 of title 42 of such Code; or

(6) Emerging and foundational technologies controlled pursuant to section 1758 of the Export Control Reform Act of 2018 (50 U.S.C. 4817).

"Substantial or essential component" means any component necessary for the proper function or performance of a piece of equipment, system, or service.

(b) *Prohibition*. In accordance with section 1656 of the National Defense Authorization Act for Fiscal Year 2018 (Pub. L. 115-91), the contractor shall not provide to the Government any equipment, system, or service to carry out covered missions that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless the covered defense telecommunication equipment or services are covered by a waiver described in Defense Federal Acquisition Regulation Supplement 204.2104 .

(c) *Procedures*. The Contractor shall review the list of excluded parties in the System for Award Management (SAM) at https://www.sam.gov for entities that are excluded when providing any equipment, system, or service, to carry out covered missions, that uses covered defense telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system, unless a waiver is granted.

(d) *Reporting*.

(1) In the event the Contractor identifies covered defense telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, the Contractor shall report at https://dibnet.dod.mil the information in paragraph (d)(2) of this clause.

(2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:

(i) Within 3 business days from the date of such identification or notification: the contract number; the order number(s), if applicable; supplier name; brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

(ii) Within 30 business days of submitting the information in paragraph (d)(2)(i) of this clause: any further available information about mitigation actions undertaken or recommended. In addition, the Contractor shall describe the efforts it undertook to prevent use or submission of a covered defense telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.

(e) *Subcontracts*. The Contractor shall insert the substance of this clause, including this paragraph (e), in all subcontracts and other contractual instruments, including subcontracts for the acquisition of commercial items.

(End of clause)

AMENDMENT 2

ATTACHMENT 2

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

DISCLOSURES OF FOREIGN AFFILIATIONS OR RELATIONSHIPS TO FOREIGN COUNTRIES

In accordance with the SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) and the Small Business Administration (SBA) SBIR/STTR Policy Directive, small business concerns are required to disclose the information requested below about the small business's investment and foreign ties.

Responses to disclosure questions may contain trade secrets or commercial or financial information that is privileged or confidential and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with an award between the submitter and the Government.

Relevant definitions can be found at the end of this document. An up-to-date list of countries determined to be countries of concern by the Secretary of State will be maintained and accessible on SBIR.gov.

Small Business Concern (SBC)	
SBC Unique Entity ID (UEI)	
Proposal # (assigned by DSIP when proposal is created)	
SBC Point of Contact (POC) Name	
SBC POC Phone #	
SBC POC Email	

The information provided in response to the Disclosure Questions listed below is certified to be accurate and complete. Knowingly and willfully making any false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to $10,000, up to five years in prison, or both.

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ______________________________

AMENDMENT 2

Disclosure Questions

1. Is any owner or covered individual of the applicant or awardee party to any malign foreign talent recruitment program?

☐ Yes ☐ No

If yes, disclose the first and last name of each owner or covered individual, identify their role (i.e., owner or covered individual), and the malign foreign talent recruitment program.

2. Is there a parent company, joint venture, or subsidiary, of the applicant or awardee that is based in or receives funding from, any foreign country of concern?

☐ Yes ☐ No

If yes, disclose the name, full address, applicant or awardee relationships (i.e., parent company, joint venture, or subsidiary) of each entity based in, or funded by, any foreign country of concern.

3. Does the applicant or awardee have any current or pending contractual or financial obligation or other agreement specific to a business arrangement, or joint venture-like arrangement with an enterprise owned by a foreign state or any foreign entity?

☐ Yes ☐ No

If yes, disclose the name of each enterprise or foreign entity, type of obligation, agreement, or arrangement (*i.e.,* contractual, financial, or other), description of obligation, agreement, or arrangement, and the foreign state(s) and/or the country of the foreign entity (or entities).

4. Is the applicant or awardee wholly owned in a foreign country?

☐ Yes ☐ No

If yes, disclose the foreign country.

5. Does the applicant or awardee have any venture capital or institutional investment?

☐ Yes ☐ No

If yes, proceed to question 5a. If no, proceed to question 6.

5a. Does the investing entity have a general partner or any other individual holding a leadership role who has a foreign affiliation with any foreign country of concern?

☐ Yes ☐ No ☐Unable to determine

If yes or unable to determine, disclose the venture capital or institutional investing entity's name, the percentage of ownership obtained by the investing entity, and the type of investment (i.e., equity, debt, or combination of equity and debt).

6. During the previous 5-year period, did the applicant or awardee have any technology licensing or intellectual property sales or transfers, to a foreign country of concern?
☐ Yes ☐ No

If yes, disclose the name, address, and country, of the institution or entity that licensed, purchased, or received the technology or intellectual property.

7. Is there any foreign business entity, offshore entity, or entity outside the United States related to the applicant or awardee?
☐ Yes ☐ No

If yes, disclose the entity name, relationship type (i.e., foreign business entity, offshore entity, entity outside the United States), description of the relationship to the applicant or awardee, and entity address and country.

8. Does the applicant or awardee have an owner, officer, or covered individual that has a foreign affiliation with a research institution located in a foreign country of concern?
☐ Yes ☐ No

If yes, disclose the first and last name of each owner, officer, or covered individual that has a foreign affiliation with a foreign country of concern, identify their role (i.e., owner, officer, or covered individual), and the name of the foreign research institution and the foreign country of concern where it is located.

Relevant Definitions

Covered individual — An individual who contributes in a substantive, meaningful way to the scientific development or execution of a research and development (R&D) project proposed to be carried out with a Federally funded award from DoD. DoD has further designated covered individuals as including all proposed key personnel.

Federally funded award — A Phase I, Phase II (including Direct to Phase II, sequential Phase II/subsequent Phase II and cross-agency Phase II), or Phase III SBIR or STTR award made using a funding agreement.

Foreign affiliation — As defined in 15 U.S.C. § 638(e)(16), foreign affiliation means a funded or unfunded academic, professional, or institutional appointment or position with a foreign government or government-owned entity, whether full-time, part-time, or voluntary (including adjunct, visiting, or honorary). This includes appointments or positions deemed adjunct, visiting, or honorary with research institutions located in a foreign country of concern.

Foreign country of concern — As defined in 15 U.S.C. § 638(e)(17), foreign country of concern means the People's Republic of China, the Democratic People's Republic of Korea, the Russian Federation, the Islamic Republic of Iran, or any other country determined to be a country of concern by the Secretary of State.

Malign foreign talent recruitment program — As defined in 42 U.S.C § 19237, the term "malign foreign talent recruitment program" means-

(C) any program, position, or activity that includes compensation in the form of cash, in-kind compensation, including research funding, promised future compensation, complimentary foreign travel, things of non de minimis value, honorific titles, career advancement opportunities, or other types of remuneration or consideration directly provided by a foreign country at any level (national, provincial, or local) or their designee, or an entity based in, funded by, or affiliated with a foreign country, whether or not directly sponsored by the foreign country, to the targeted individual, whether directly or indirectly stated in the arrangement, contract, or other documentation at issue, in exchange for the individual-

- (x) engaging in the unauthorized transfer of intellectual property, materials, data products, or other nonpublic information owned by a United States entity or developed with a Federal research and development award to the government of a foreign country or an entity based in, funded by, or affiliated with a foreign country regardless of whether that government or entity provided support for the development of the intellectual property, materials, or data products;
- (xi) being required to recruit trainees or researchers to enroll in such program, position, or activity;
- (xii) establishing a laboratory or company, accepting a faculty position, or undertaking any other employment or appointment in a foreign country or with an entity based in, funded by, or affiliated with a foreign country if such activities are in violation of the standard terms and conditions of a Federal research and development award;
- (xiii) being unable to terminate the foreign talent recruitment program contract or agreement except in extraordinary circumstances;
- (xiv) through funding or effort related to the foreign talent recruitment program, being limited in the capacity to carry out a research and development award or required to engage in work that would result in substantial overlap or duplication with a Federal research and development award;
- (xv) being required to apply for and successfully receive funding from the sponsoring foreign government's funding agencies with the sponsoring foreign organization as the recipient;
- (xvi) being required to omit acknowledgment of the recipient institution with which the individual is affiliated, or the Federal research agency sponsoring the research and development award, contrary to the institutional policies or standard terms and conditions of the Federal research and development award;
- (xvii) being required to not disclose to the Federal research agency or employing institution the participation of such individual in such program, position, or activity; or
- (xviii) having a conflict of interest or conflict of commitment contrary to the standard terms and conditions of the Federal research and development award; and

(D) a program that is sponsored by-

- (iv) a foreign country of concern or an entity based in a foreign country of concern, whether or not directly sponsored by the foreign country of concern;

AMENDMENT 2

(v) an academic institution on the list developed under section 1286(c)(8) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232) ; or

(vi) a foreign talent recruitment program on the list developed under section 1286(c)(9) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (10 U.S.C. 2358 note; 1 Public Law 115–232).

AMENDMENT 2

ATTACHMENT 3

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

Verification of Eligibility of Small Business Joint Ventures

A small business joint venture offeror must submit, with its offer, the representation required in paragraph (c) of FAR solicitation provision 52.212-3, Offeror Representations and Certifications-Commercial Products and Commercial Services, and paragraph (c) of FAR solicitation provision 52.219-1, Small Business Program Representations, in accordance with 52.204-8(d) and 52.212-3(b) for the following categories:

(A) Small business;
(B) Service-disabled veteran-owned small business;
(C) Women-owned small business (WOSB) under the WOSB Program;
(D) Economically disadvantaged women-owned small business under the WOSB Program; or
(E) Historically underutilized business zone small business

Contractor’s Name	
Small Business Concern Name	
Office Tel #	
Mobile #	
Email	

Name of person authorized to sign: ____

Signature of person authorized: ____

Date: ______________________________

FAR Provision Incorporated in Full Text:

52.219-1 Small Business Program Representations (Oct 2022)

(a) *Definitions*. As used in this provision-

Economically disadvantaged women-owned small business (EDWOSB) concern means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States and who are economically disadvantaged in accordance with 13 CFR part 127, and the concern is certified by SBA or an approved third-party certifier in accordance with 13 CFR 127.300. It automatically qualifies as a women-owned small business concern eligible under the WOSB Program.

Service-disabled veteran-owned small business concern-

(1) Means a small business concern-

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) "Service-disabled veteran" means a veteran, as defined in 38 U.S.C.101(2), with a disability that is service-connected, as defined in 38 U.S.C.101(16).

Small business concern—

(1) Means a concern, including its affiliates, that is independently owned and operated, not dominant in its field of operation, and qualified as a small business under the criteria in 13 CFR part 121 and the size standard in paragraph (b) of this provision.

(2) *Affiliates*, as used in this definition, means business concerns, one of whom directly or indirectly controls or has the power to control the others, or a third party or parties control or have the power to control the others. In determining whether affiliation exists, consideration is given to all appropriate factors including common ownership, common management, and contractual relationships. SBA determines affiliation based on the factors set forth at 13 CFR 121.103.

Small disadvantaged business concern, consistent with 13 CFR 124.1002, means a small business concern under the size standard applicable to the acquisition, that-

(1) Is at least 51 percent unconditionally and directly owned (as defined at 13 CFR 124.105) by-

(i) One or more socially disadvantaged (as defined at 13 CFR 124.103) and economically disadvantaged (as defined at 13 CFR 124.104) individuals who are citizens of the United States, and

(ii) Each individual claiming economic disadvantage has a net worth not exceeding $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(2) The management and daily business operations of which are controlled (as defined at 13 CFR 124.106) by individuals who meet the criteria in paragraphs (1)(i) and (ii) of this definition.

Veteran-owned small business concern means a small business concern-

AMENDMENT 2

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C.101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern-

(1) That is at least 51 percent owned by one or more women; or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

Women-owned small business (WOSB) concern eligible under the WOSB Program (in accordance with 13 CFR part 127) means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States, and the concern is certified by SBA or an approved third-party certifier in accordance with 13 CFR 127.300.

(b) (1) The North American Industry Classification System (NAICS) code for this acquisition is _________ *[insert NAICS code]*.

(2) The small business size standard is ________ *[insert size standard]*.

(3) The small business size standard for a concern that submits an offer, other than on a construction or service acquisition, but proposes to furnish an end item that it did not itself manufacture, process, or produce (*i.e.*, nonmanufacturer), is 500 employees if the acquisition—

(i) Is set aside for small business and has a value above the simplified acquisition threshold;

(ii) Uses the HUBZone price evaluation preference regardless of dollar value, unless the offeror waives the price evaluation preference; or

(iii) Is an 8(a), HUBZone, service-disabled veteran-owned, economically disadvantaged women-owned, or women-owned small business set-aside or sole-source award regardless of dollar value.

(c) *Representations.*

(1) The offeror represents as part of its offer that—

(i) it ☐is, ☐ is not a small business concern; or

(ii) It ☐is, ☐is not a small business joint venture that complies with the requirements of 13 CFR 121.103(h) and 13 CFR 125.8(a) and (b). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.]

AMENDMENT 2

(2) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents that it ☐is, ☐ is not, a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.]* The offeror represents as part of its offer that it ☐ is, ☐ is not a women-owned small business concern.

(4) *Women-owned small business (WOSB) joint venture eligible under the WOSB Program.* The offeror represents as part of its offer that it ☐ is, ☐ is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.]

(5) *Economically disadvantaged women-owned small business (EDWOSB) joint venture.* The offeror represents as part of its offer that it ☐ is, ☐ is not a joint venture that complies with the requirements of 13 CFR 127.506(a) through (c). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.]

(6) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents as part of its offer that it ☐ is, ☐ is not a veteran-owned small business concern.

(7) [*Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (c)(6) of this provision.*] The offeror represents as part of its offer that

(i) It ☐ is, ☐ is not a service-disabled veteran-owned small business concern; or

(ii) It ☐ is, ☐ is not a service-disabled veteran-owned joint venture that complies with the requirements of 13 CFR 125.18(b)(1) and (2). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.] Each service-disabled veteran-owned small business concern participating in the joint venture shall provide representation of its service-disabled veteran-owned small business concern status.

(8) [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents, as part of its offer, that-

(i) It ☐ is, ☐ is not a HUBZone small business concern listed, on the date of this representation, as having been certified by SBA as a HUBZone small business concern in the Dynamic Small Business Search and SAM, and will attempt to maintain an employment rate of HUBZone residents of 35 percent of its employees during performance of a HUBZone contract (see 13 CFR 126.200(e)(1)); and

(ii) It ☐ is, ☐□ is not a HUBZone joint venture that complies with the requirements of 13 CFR 126.616(a) through (c). [*The offeror shall enter the name and unique entity identifier of each party to the joint venture:* __.] Each HUBZone small business concern participating in the HUBZone joint venture shall provide representation of its HUBZone status.

AMENDMENT 2

(d) *Notice.* Under 15 U.S.C.645(d), any person who misrepresents a firm's status as a business concern that is small, HUBZone small, small disadvantaged, service-disabled veteran-owned small, economically disadvantaged women-owned small, or women-owned small eligible under the WOSB Program in order to obtain a contract to be awarded under the preference programs established pursuant to section 8, 9, 15, 31, and 36 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall-

(1) Be punished by imposition of fine, imprisonment, or both;

(2) Be subject to administrative remedies, including suspension and debarment; and

(3) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

AMENDMENT 2

Attachment 4

Department of Defense (DoD)
Small Business Innovation Research (SBIR) Program
Small Business Technology Transfer (STTR) Program

DISCLOSURE OF FUNDING SOURCES

In accordance with Section 223 of the William M. (Mac) Thornberry National Defense Authorization Act (NDAA) for Fiscal Year 2021, DoD shall require, as part of any application for a research and development award—

- (1) that each covered individual listed on the application—
  - (A) disclose the amount, type, and source of all current and pending research support received by, or expected to be received by, the individual as of the time of the disclosure;
  - (B) certify that the disclosure is current, accurate, and complete; and
  - (C) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award; and
- (2) that any entity applying for such award certify that each covered individual who is employed by the entity and listed on the application has been made aware of the requirements under paragraph (1).

Full text of Section 223 of the FY21 NDAA, including relevant definitions, can be found on pages 84-86: https://www.congress.gov/116/plaws/publ283/PLAW-116publ283.pdf.

Small Business Concern (SBC)	
SBC Unique Entity ID (UEI)	
Proposal # (assigned by DSIP when proposal is created)	
SBC Point of Contact (POC) Name	
SBC POC Phone #	
SBC POC Email	

The SBC has been made aware of the requirements outlined in Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 and certifies that the disclosures provided below are current, accurate, and complete. The SBC further agrees to update such disclosure at the request of DoD prior to the award of support and at any subsequent time DoD determines appropriate during the term of the award.

Name of person authorized to sign: ______________________________

Signature of person authorized: ______________________________

Date: ______________________________

AMENDMENT 2

☐ Covered individuals have no current or pending research support to disclose in accordance with Section 223 of the FY21 NDAA, as described above.

Disclosures

Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	
Covered Individual's Name: Covered Individual's Position: Current and Pending Funding Amount: Current and Pending Funding Type: Current and Pending Funding Source:	

AMENDMENT 2

[Additional space as needed]

ARMY 23.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The U.S. Army Combat Capabilities Development Command (CCDC) is responsible for execution of the Army SBIR Program. Information on the Army SBIR Program can be found at the following Website: https://www.armysbir.army.mil/.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. Army requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the Army SBIR Program should be submitted to:

Monroe Harden
Fundamental Portfolio Manager, Army SBIR
usarmy.apg.ccdc.mbx.sbir-program-managers-helpdesk@mail.mil
U.S. Army Combat Capabilities Development
Command6662 Gunner Circle
Aberdeen Proving Ground, MD
21005-1322TEL: 866-570-7247

The Army participates in up to three DOD SBIR BAAs each year. Proposals not conforming to the terms this BAA will not be considered. Only Government personnel will evaluate proposals.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

PHASE I PROPOSAL SUBMISSION

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD Program BAA.

The Technical Volume (Volume 2) .pdf document has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments.DSIP contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheet, the Cost Volume, and how to upload the Technical Volume. For questions regarding proposal electronic submission, contact DSIP Support at DoDSBIRSupport@reisystems.com.

The small business will also need to register at the Army SBIR Small Business website: https://sbir.army.mil/SmallBusiness/ in order to receive information regarding proposal status/debriefings, summary reports, impact/transition stories, and Phase III plans. PLEASE NOTE: If this is your first time submitting an Army SBIR proposal, you will not be able to register your firmat the Army SBIR Small Business website until after all of the proposals have been downloaded and we have transferred your company information to the Army Small Business website. This can takeup to one week after the end of the proposal submission period.

Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically generated Cover Sheets and Cost Volume are excluded from the 20-page limit. **Army Phase I proposals submitted containing a Technical Volume .pdf document containing over 20 pages will be deemed NON-COMPLIANT and will not be evaluated. It is theresponsibility of the Small Business to ensure that once the proposal is submitted and uploaded into the system that the technical volume .pdf document complies with the 20 page limit.**

Phase I proposals must describe the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

Phase I proposals will be reviewed for overall merit based upon the criteria in Section 6.0 of the DOD Program BAA.

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

The Army implements the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to have the Phase I Option exercised. The Phase I Option, which **must** be included as part of the Phase I proposal, should cover activities over a period of up to four months and describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limit for the Phase I proposal. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume such as descriptions of capability or intent, in other sections of the proposal as these will count toward the 20 page limit.

PHASE I COST VOLUME

A firm fixed price or cost plus fixed fee Phase I Cost Volume with maximum dollar amount of **$167,500** must be submitted in detail online. Proposers that participate in this BAA must complete a Phase I Cost Volume not to exceed a maximum dollar amount of **$111,500** for the six months base period and a Phase I Option Cost Volume not to exceed a maximum dollar amount of **$56,000** for the four months option period. The Phase I and Phase I Option costs must be shown separately but may be presented side-by-side in a single Cost Volume. The system generated Cost Volume DOES NOT count toward the 20-page Phase I proposal limitation when submitted via the submission site's on-line form. When submitting the Cost Volume, complete the Cost Volume form on the DOD Submission site, versus submitting it within the body of theuploaded proposal.

The Army will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

PHASE II PROPOSAL SUBMISSION

Only Small Businesses that have been awarded a Phase I contract for a specific topic can submit a Phase

II proposal for that topic. Small businesses submitting a Phase II Proposal must use the DOD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/)This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheet, theCost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DOD Help Desk at DoDSBIRSupport@reisystems.com.

For projects awarded in cycle 23.2, there will be **ONE window for submission** of Phase II proposals. A single Phase II proposal can be submitted by a Phase I awardee within one, and only one, Phase II submission window. The submission window opens at 0001hrs (12:01 AM) eastern time on the first day and closes at 2359 hrs (11:59 PM) eastern time on the last day. Any subsequent or Sequential Phase II proposal (i.e., a second Phase II subsequent to the initial Phase II effort) shall be initiated by the Government Technical Point of Contact for the initial Phase II effort and must be approved by Army SBIR PM in advance.

The 2025(a) Phase II proposal submission window for Phase I contracts awarded under the 23.2 cycle opens for submission on 15 October 2024 and closes on 14 November 2024.

Army SBIR Phase II Proposals have three Volumes: Proposal Cover Sheet, Technical Volume, and Cost Volume. The Technical Volume .pdf document has a 38-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes), data assertions and any attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 38 page limit. As with Phase I proposals, it is the proposing firm's responsibility to verify that the Technical Volume .pdf document does not exceed the page limit after upload to the DOD SBIR/STTR Submissionsite by clicking on the "Verify Technical Volume" icon.

Only the electronically generated Cover Sheet and Cost Volume are excluded from the 38-pageTechnical Volume.

Army Phase II Proposals submitted containing a Technical Volume .pdf document over 38 pages will be deemed NON-COMPLIANT and will not be evaluated.

Army Phase II Cost Volumes must contain a budget for the entire 24 month Phase II period not to exceed the maximum dollar amount of **$1,100,000.** During contract negotiation, the contracting officer may require a Cost Volume for year one and year two. The proposal cost volumes must be submitted using the Cost Volume format (accessible electronically on the DOD submission site), and may be presented side-by-side on a single Cost Volume Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the first year prior to extending funding for the second year.

Small businesses submitting a proposal are required to develop and submit a technology transition and commercialization plan describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal.

DOD is not obligated to make any awards under Phase I, II, or III. For specifics regarding the evaluation and award of Phase I or II contracts, please read the DOD Program BAA very carefully. Phase II proposals will be reviewed for overall merit based upon the criteria in the DoD Program BAA.

BIO HAZARD MATERIAL AND RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

Any proposal involving the use of Bio Hazard Materials must identify in the Technical Volume whetherthe contractor has been certified by the Government to perform Bio Level - I, II or III work.

Companies should plan carefully for research involving animal or human subjects, or requiring access togovernment resources of any kind. Animal or human research must be based on formal protocols that arereviewed and approved both locally and through the Army's committee process. Resources such as equipment, reagents, samples, data, facilities, troops or recruits, and so forth, must all be arranged carefully. The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

OZONE CHEMICALS

Class 1 Ozone Depleting Chemicals/Ozone Depleting Substances are prohibited and will not be allowedfor use in this procurement without prior Government approval.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA) (FORMERLY KNOWN AS DISCRETIONARY TECHNICAL ASSISTANCE)

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), the Army will provide technical assistance services to small businesses engaged in SBIR projects through a network of scientistsand engineers engaged in a wide range of technologies. The objective of this effort is to increase Army SBIR technology transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth.

The Army has a Technical Assistance Advocate (TAA) to provide technical assistance to small businesses that have Phase I and Phase II projects with the participating organizations within their regions.

For more information go to: https://www.armysbir.army.mil, then click the "SBIR" tab, and thenclick on Transition Assistance/Technical Assistance.

This technical and business assistance to SBIR awardees to assist in:

- Making better technical decisions on SBIR projects
- Solving technical problems that arise during SBIR
- projects;
- Minimizing technical risks associated with SBIR projects; and
  Developing and commercializing new commercial products and processesresulting from such projects including intellectual property protections.

Army may provide up to $5,000 of SBIR funds for the technical assistance described above for each Phase I award, and $10,000 per Phase II project to these vendors for direct support to SBIR awardees.

Alternatively, an SBIR firm may directly acquire the technical assistance services described above and not through the vendor selected by the Components. Firms must request this authority from the agency and clearly identify the need for assistance (purpose and objective of required assistance), provide details on the provider of the assistance (name and point of contact for performers) and why the proposed TABA providers are uniquely skilled to conduct the work (specific experience in providing the assistance proposed), and the cost of the required assistance (costs and hours proposed or other details on arrangement). This information must be included in the Explanatory Material section of the firm's cost proposal specifically identified as "Discretionary Technical and Business Assistance."

If the awardee demonstrates this requirement sufficiently, the agency shall permit the awardee to acquire such technical assistance itself, in an amount up to $5,000 for each Phase I award and $10,000 for each Phase II project, as an allowable cost of the SBIR award. The per year amount will be in addition to the award and is not subject to any profit or fee by the requesting (SBIR) firm and is inclusive of all indirect rates.

The TABA provider may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

Failure to include the required information in the Phase I and/or Phase II proposal will result in the request for discretionary technical and business assistance being disapproved. Requests for TABA funding outside of the Phase I or Phase II proposal submission will not be considered. If the firm is approved for TABA from a source other than that provided by the agency, the firm may not be eligible for the technical assistance services normally provided by those organizations. Small business concerns that receive technical or business assistance as described in this section are required to submit a description of the assistance provided, and the benefits and results achieved. Contact the Army SBIR Program Office for any other considerations.

NOTE: The Small Business Administration (SBA) is currently developing regulations governing TABA. All regulatory guidance produced by SBA will apply to any SBIR contracts where TABA is utilized.

It should also be noted that if approved for discretionary technical and business assistance from an outside source, the firm will not be eligible for the Army's Technical Assistance Advocate support. All details of the TABA agency and what services they will provide must be listed in the technical proposal under "consultants". The request for TABA must include details on what qualifies the TABA firm to provide the services that you are requesting, the firm name, a point of contact for the firm, and a web site for the firm. List all services that the firm will provide and why they are uniquely qualified to provide these services. The award of TABA funds is not automatic and must be approved by the Army SBIR Program Manager. The maximum TABA dollar amount that can be requested in a Phase I Army SBIR proposal is $5,000. The maximum TABA dollar amount that can be requested in a Phase II Army SBIR proposal is $5,000 per year (for a total of $10,000 for two years).

COMMERCIALIZATION READINESS PROGRAM (CRP)

The objective of the CRP effort is to increase Army SBIR technology transition and commercialization success and accelerate the fielding of capabilities to Soldiers. The CRP: 1) assesses and identifies SBIR projects and companies with high transition potential that meet high priority requirements; 2) matches SBIR companies to customers and facilitates collaboration; 3) facilitates detailed technology transition plans and agreements; 4) makes recommendations for additional funding for select SBIR projects that meet the criteria identified above; and 5) tracks metrics and measures results for the SBIR projects within the CRP.

Based on its assessment of the SBIR project's potential for transition as described above, the Army utilizes a CRP investment fund of SBIR dollars targeted to enhance ongoing Phase II activities with expanded research, development, test and evaluation to accelerate transition and commercialization. The

CRP investment fund must be expended according to all applicable SBIR policy on existing Phase II availability of matching funds, proposed transition strategies, and individual contracting arrangements.

NON-PROPRIETARY SUMMARY REPORTS

All award winners must submit a non-proprietary summary report at the end of their Phase I project andany subsequent Phase II project. The summary report is unclassified, non-sensitive and non-proprietary and should include:

- A summation of Phase I results
- A description of the technology being
- developedThe anticipated DOD and/or
- non-DOD customer
- The plan to transition the SBIR developed technology to the customer
- The anticipated applications/benefits for government and/or private sector useAn image depicting the developed technology

The non-proprietary summary report should not exceed 700 words, and is intended for public viewing onthe Army SBIR/STTR Small Business area. This summary report is in addition to the required final technical report and should require minimal work because most of this information is required in the finaltechnical report. The summary report shall be submitted in accordance with the format and instructions posted within the Army SBIR Small Business Portal at: https://sbir.army.mil/SmallBusiness/ and is due within 30 days of the contract end date.

ARMY SBIR PROGRAM COORDINATORS (PCs) for Army SBIR PHASE 23.2

Participating Organizations	Program Coordinator	Phone
Armaments Center (AC)	Ben Call Peter Susberich	973-724-6275 973-724-5783
Aviation and Missile Center (AvMC-A)	Dawn Gratz	256-842-8769
Aviation and Missile Center (AvMC-M)	Dawn Gratz	256-842-8769
Army Research Laboratory (ARL)	Zeke Topolosky	301-394-2070
Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR)	Tamarisk Gillespie	703-704-0124
Chemical Biological Center (CBC)	Martha Weeks	410-436-5391
Engineer Research and Development Center (ERDC)	Melonise Wills	703-428-6281
Soldier Center (SC)	Cathryn Polito	508-206-3497

ARMY SUBMISSION OF FINAL TECHNICAL REPORTS

A final technical report is required for each project. Per DFARS clause 252.235-7011 (http://www.acq.osd.mil/dpap/dars/dfars/html/current/252235.htm#252.235-7011), each contractor shall

(a) Submit two copies of the approved scientific or technical report delivered under the contract to the Defense Technical Information Center, Attn: DTIC-O, 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218; (b) Include a completed Standard Form 298, Report Documentation Page, with each copy ofthe report; and (c) For submission of reports in other than paper copy, contact the Defense Technical Information Center or follow the instructions at http://www.dtic.mil.

PROTEST PROCEDURES

Refer to the DoD SBIR Program Announcement for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: Monroe Harden, Army Fundamental SBIR Portfolio Director, at Monroe.b.harden2.civ@army.mil .

NOTIFICATION OF SELECTION OR NON-SELECTION

Proposing firms will be notified of selection or non- selection status for a Phase I award within 90 days of the closing date of the BAA. The individual named as the Corporate Official on the Proposal Cover Sheet will receive an email for each proposal submitted from the Army SBIR portal with their official notification of proposal selection or non-selection.

DEPARTMENT OF THE ARMY PROPOSAL CHECKLIST

This is a Checklist of Army Requirements for your proposal. Please review the checklist to ensure that your proposal meets the Army SBIR requirements. You must also meet the general DOD requirements specified in the BAA. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$111,500** with up to a six-month duration) AND an optional effort (up to **$56,000** for an up to four-month period to provide interim Phase II funding).

2. The proposal is limited to only **ONE** Army BAA topic.

3. The technical content of the proposal, including the Option, includes the items identified in the DoD Program BAA.

4. The Technical Volume .pdf document has a 20-page limit including, but not limited to: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents [e.g., statements of work and resumes] and all attachments).

   Offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposalsubmission as THESE WILL COUNT AGAINST THE 20-PAGE LIMIT. Any information that details work involved that should be in the technical volume but is inserted into other sections of the proposal will count against the page count. ONLY the electronically generated Cover Sheet and Cost Volume are excluded from the Technical Volume .pdf 20-page limit. Army Phase I proposals submitted with a Technical Volume .pdf document of over 20-pages will be deemed NON-COMPLIANT and will not be evaluated.

5. The Cost Volume has been completed and submitted for both **the Phase I and Phase I Option** and the costs are shown separately. The Army requires that small businesses complete the Cost Volume form on the DOD Submission site, versus submitting within the body of the uploaded proposal. The total cost should match the amount on the coversheet.

6. If applicable, the Bio Hazard Material level has been identified in the Technical Volume.

7. If applicable, plan for research involving animal or human subjects, or requiring access togovernment resources of any kind.

8. The Phase I Proposal describes the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

9. If applicable, Foreign Nationals are to be identified in the proposal.

Army SBIR 23.2 Topic Index

A23-001	Lightweight, Robust, Ruggedized North Finding Technology
A23-002	Development of polarimetric SWIR camera system with AI/ML capabilities to counter swarming UAVs
A23-003	Electromagnetic Skins and Smart RF Radomes for Spectrum Camouflage
A23-004	UAS Continuous Time Spectrum Situational Awareness
A23-005	Open Source, High Assurance Hardware and Software Co-Design
A23-006	Advanced III-V avalanche photodiode structures in the infrared
A23-007	Multi-Modal Synthetic Data Corpus to Support Machine Intelligence Development
A23-008	Wideband RF Sensing Algorithms for Detection of Priority Ground RF-Enabled Threats
A23-009	Zero Trust Identity
A23-010	Open Multi-Sensor Counter Unmanned Aerial Systems (C-UAS) Software System
A23-011	Operations in Degraded Visual Environments using Millimeter Wave Imagery
A23-012	Adapting commercial technologies to deliver the Modular Attributable Sensor System (MASS), an array of AI-enabled sensor nodes interoperable with the Unified Network
A23-013	Real-Time Analytics for Engineer Reconnaissance
A23-014	Persistent Intelligence, Surveillance, and Reconnaissance via Perching Unmanned Air Vehicles

A23-001 TITLE: Lightweight, Robust, Ruggedized North Finding Technology

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. 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: The purpose of this topic is to demonstrate a rugged, lightweight, compact north-finding technology that can provide a precise measurement of heading relative to true north in GPS-denied environments and in the presence of interference, such as magnetic fields or overcast skies.

DESCRIPTION: Recent advances in MEMS-based technology offer the promise of rapidly measuring azimuth with high accuracy and in a small, ruggedized form factor. The desired application for this technology is the orientation of weapons platforms (e.g., mortar systems), radar system configuration. The technology should also be suitable as a and-alone navigation aid for soldiers in austere environments,. The technology should offer the capability to provide the measured heading to the user or to a host system in which the technology is embedded.

PHASE I: Design a proof-of-concept for a lightweight, compact north-finding system capable of either standalone or platform-integrated operation. The design should include hardware and software integration and a detailed description of how a user or system integrator would interact with the system. The final deliverables will be a breadboard demonstration of the proposed technology and a concept design presentation featuring anticipated performance, size, weight, power and cost estimates for the system.

PHASE II: Develop and deliver a TRL 7 prototype low-cost north-finding device that can be utilized as a standalone system or as a component of a larger system. Demonstrate the sensor in a relevant representative environment. The prototype must have a modular open system architecture that can be integrated into existing and future Army systems for demonstration, testing and evaluation across a range of training and operational environments. The prototype should be able to measure heading relative to True North to within Threshold [T] 1, objective [O] 0.2 degree(s). The prototype should include a detailed interface design that would allow a systems integrator to easily incorporate the north-finding technology into its system. The prototype should feature a user manual describing how a user can perform a heading measurement in a standalone use case.

PHASE III DUAL USE APPLICATIONS: A low-cost, lightweight north-finding technology can be utilized in systems that otherwise do not have an easy and accurate way to determine heading to north due to interference, such as counter-UAS or counter-fire radar systems. The north-finding capability would enhance products like the Army's Weaponized Universal Lightweight Fire Control (WULF) system, enabling it to more accurately calculate mortar firing solutions for users. For Soldiers navigating unfamiliar terrain, the system could be set down and allowed to perform a measurement to provide the soldier with a heading for orienteering in place of the M2 Compass. In the commercial market, north-finding would be useful for surveyors to obtain accurate measurements of landmark positions or on ships as an alternative to larger navigation tools currently in use.

REFERENCES:

1. Gade, Kenneth. The Seven Ways to Find Heading. Journal of Navigation, 955-970. 2016.
2. FIELD MANUAL 23-90. Mortars. March 2000.
3. Lechner, Wolfgang. AZIMUTH DETERMINATION WITH INERTIAL SYSTEMS, International Federation of Surveyors – FIG Proceedings
4. Hovde, Stian. Compact Sensor System for Target Localization, 2017.
5. The road to providing a faster, more accurate mortar firing system | Article | The United States Army
6. Kaplan, George H. Determining the Position and Motion of a Vessel from Celestial Observations.
7. Matthews et al. Azimuth Determination using a Low Noise Ring Laser Gyro Inertial Measurement Unit. Report Number AFGL-TR-82-0356.
8. FIELD MANUAL 3-25.26. Map Reading and Land Navigation. 2001

KEYWORDS: Navigation; north-finding; MEMS; orientation.

A23-002 TITLE: Development of polarimetric SWIR camera system with AI/ML capabilities to counter swarming UAVs

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. 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 polarimetric SWIR camera system with incorporated artificial intelligence and machine learning (AI&ML) capability for enhanced target detection/identification, and tracking of swarming UAVs.

DESCRIPTION: To overcome limitations inherent in conventional image-based targeting systems, (e.g., visible and conventional thermal vision systems) a polarimetrically filtered SWIR camera system based on new high resolution FPA technology is to be developed. [1-3] New SWIR FPAs cost a fraction of the cost (compared to cooled thermal FPAs) and exhibit nearly twice the spatial resolution of their thermal counterparts. similarly, new SWIR FPA readout technology is capable of producing very large dynamic range resulting in exceptionally low light sensitivity.
To address the highly asymmetric nature of a UAV swarming event, the polarimetric image stream would be analyzed in real-time by an AI&ML algorithm to produce maximum situational awareness. By introducing a polarimetric capability, target imagery is expected to display enhanced information content which can be further exploited by AI/ML analysis. [4-6] AI&ML algorithm developers should consider recent advances in deep neural networks (DNN) and the maturation of graphical processing unit (GPU) technology optimized for intensive matrix computations. Such AI&ML algorithms are expected to be trained relatively quickly on low-cost GPUs to perform inference on GPUs in real-time. [7-8] Finalized system should be capable of providing appropriate targeting parameters for gimble mounted offensive system to be determined (TBD).

PHASE I: During the initial solicitation candidates must identify 1) the optical design proposed for the SWIR polarimetric camera system, and 2) hardware, architecture, and algorithm(s) for the AI&ML operation of the system. As a result, during the Phase I candidates will be expected to conduct a feasibility study which will consist of predictive analysis and/or preliminary prototype development in support of their proposed polarimetric/AI&ML design. This should include identifying and assessing (with costs) all critical components necessary to develop the proposed system. Specifically, the candidate should define and identify particular focal-plane-array (FPA) architecture, readout circuitry, minimum integration time, optical design, spectral responsivity, and control/analysis hardware and software required for high resolution, high frame-rate operation. To provide the enhanced spatial and textural detail required for robust targeting, the polarimetric camera system must be capable of producing in real-time a minimum of the following Stokes imagery, i.e., S0, S1, S2, and a degree-of-linear-polarization (DoLP) image.[9-10] Analysis should include optical design modeling and optimization in which both radiometric and polarimetric response characteristics are predicted, e.g., noise-equivalent-delta-polarization-state (NEDP). Candidates should strive to achieve a minimum acceptable NEDP of ±1%.

PHASE II: Based on the design criteria established during the Phase I, the candidate will procure all necessary components to assemble, test, and demonstrate a fully functional prototype device. Testing will also include evaluation of AI&ML algorithms based on specific test objectives, e.g., percentage of UAVs accurately located/targeted per swarming event and the ability to discern avian clutter from a true threat. Prototype testing and evaluation will be conducted at a government facility in which optimum functionality will be determined based on range, atmospheric conditions, and tactical scenario. To be conducted concurrent with the prototype development, the contractor will begin identifying all possible commercialization opportunities and partnerships necessary to successfully bring their developed intellectual property (IP) to market.

PHASE III DUAL USE APPLICATIONS: Upon successful completion of Phase II, the contractor may be asked to demonstrate developed AI&ML polarimetric imaging target and tracking system vera the interfacing with identified C-UAV offensive device. Such evaluation will take place at an appropriate U.S. Army field-test facility. This will also include further maturation of the system in which reduction in size, weight, and power (SWaP) will be examined. The candidate is expected to pursue civilian applications and additional commercialization opportunities, e.g., remote sensing of geological formations, enhanced surveillance for homeland/boarder security, detection of buried landmines and IEDs, identification of camouflaged/hidden targets, and night-time facial recognition. [11-14]

REFERENCES:

1. Tyo J, Goldstein D, Chenault D, Shaw J. Review of passive imaging polarimetry for remote sensing. Appl Opt. 2006;45(22).
2. B. Preece, R. Thompson, V. Hodgkin, K. Gurton, D. Tomkinson, H. Choi, K. Krapels, “Performance Comparison of Conventional IRST (Infrared Search and Track) Sensor versus Polarimetric IRST for the Detection of UAS”, 2014 Military Sensing Symposia (MSS) National Symposium on Sensor & Data Fusion, Springfield, VA. Oct. 28-31, (2014).
3. Gurton K.P. Calibrated long-wave infrared (LWIR) thermal and polarimetric imagery of small unmanned aerial vehicles (UAVs) and birds. Army Research Laboratory (US); 2018 Aug. Report No.: ARL-TR-8475.
4. Gurton K, Yuffa A, Videen G. Enhanced facial recognition for thermal imagery using polarimetric imaging. Opt. Lett. 2014;39(13):3857–3859.
5. Gurton K, Felton M, Pezzaniti L. Remote detection of buried land-mines and IEDs using LWIR polarimetric imaging. Optics Express. 2012;20:22344–22359.
6. Gurton, K and Edmondson, R, "MidIR and LWIR Thermal Polarimetric Imaging Comparison using Receiver Operating Characteristic (ROC) Curve Analysis," ARL Technical Report, ARL-TR-9092, October 2020
7. J. Dai, H. Qi, Y. Xiong, Y. Li et al., “Deformable convolutional networks”, IEEE International Conference on Computer Vision (ICCV), October 22-29 (2017), Venice, Italy.
8. K. He, X. Zhang, S. Ren, and J. Sun, “Spatial pyramid pooling in deep convolutional neural networks for visual recognition”, IEEE Trans. On Pattern Analysis and Machine Intelligence, 37(9), pp. 1904-1916, (2015).
9. Gurton, K., M. A. Felton, R. Mack, C. Farlow, L. Pezzaniti, M. W. Kudenov, D. LeMaster, “MidIR and LWIR polarimetric sensor comparison study”, Proc. SPIE, Polarization: Measurement, Analysis, and Remote Sensing IX, 0277-786, vol. 7672 (2010).
10. Duncan L. Hickman, Moira I. Smith, Kyung Su Kim, Hyun-Jin Choi, "Polarimetric imaging: system architectures and trade-offs," Proc. SPIE 10795, Electro-Optical and Infrared Systems: Technology and Applications XV, 107950B (9 October 2018); doi: 10.1117/12.2325320
11. K. Gurton, M. Felton, L. Pezzaniti, “Remote detection of buried land-mines and IEDs using LWIR polarimetric imaging”, Optics Express, Vol. 20 Issue 20, pp.22344-22359 (2012).
12. A. Yufa, K. Gurton, G. Videen, “Three-dimensional (3D) facial recognition using passive LWIR polarimetric imaging”, Appl. Opt. vol. 53, no. 36, pp. 8514-8521, Dec. (2014).
13. N. Short, S. Hu, P. Gurram, K. Gurton, A. Chan, “Improving cross-modal face recognition using polarimetric imaging”, Optics Letters vol. 40, 6, pp. 882-885 (2015).

14. L. Pezzaniti, D. Chenault, K. Gurton, M. Felton, “Detection of obscured targets with IR polarimetric imaging”, Proc. SPIE 9072, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XIX, 90721D, May 29, (2014).

KEYWORDS: Vision systems, artificial intelligence (AI), machine learning (ML), polarimetric imaging, anomaly detection, SWIR, drone detection, counter-UAV

A23-003 TITLE: Electromagnetic Skins and Smart RF Radomes for Spectrum Camouflage

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

OBJECTIVE: Design and build an electrically thin electromagnetic (EM) skin to absorb, scatter, and change the polarization of undesirable radio frequency (RF) radiation providing spectrum camouflage for Army antennae and radar systems. The objective of this SBIR is to utilize novel EM skins by adding RF functionality to create a Smart Radome surface to apply to airborne platforms or Smart Munitions.

DESCRIPTION: We define an Electromagnetic (EM) skin as a thin layer of radio frequency (RF) components and/or periodic structures conformed to an Army platform that manipulate radiation or scattering parameters. Thin EM skins will occupy areas designed and shaped primarily for mechanical and environmental functions. One example is an antenna radome which is a protective enclosure surrounding an antenna. The radome is made of a material that minimally attenuates transmit and receive signals from the enclosed antenna. Many applications, such as airborne platforms or Smart Munitions, use curved radomes and must maintain performance under extremely harsh environments (i.e., high velocity and high acceleration conditions). Application requirements will impact the size and geometrical shape of the radome, and these requirements may cause a noticeable radar cross section (RCS) signature. An EM Skin can exist on the surface of such a radome as a frequency selective surface that allows desirable frequencies to penetrate the radome while absorbing undesirable bands to greatly reduce undesirable RF scattering. Additional functions these EM skins may perform include beamforming, transceiver operation, deception through signal polarization conversion, transmit signal coding, and anti-jamming operations. The added functionality creates a SMART Radome which performs important RF functions in addition to its original purpose of protecting the enclosed antenna. This can't be done with conventional materials while maintaining the mechanical and aerodynamic properties of Army platforms. This SBIR will address two important topics to produce a functional Smart Radome utilizing an EM skin. First is the design of electronic RF components and subsystems that produce the EM skin's required RF functionality. These RF components must fit within the thin bounds of the skin which will be on the order of 5 mm or less. The second topic of study is the mechanical, thermal, and environmental aspects of integrating the EM skin onto selected Army platforms. A major concern is the stability of EM performance on conformal platforms, airborne drag effects, and the extreme thermal and high-G conditions of munitions. Both topics must be addressed before considering the integration of SMART Radomes onto airborne platforms or munitions.

PHASE I: In Phase I, the investigation shall explore the underlying technologies used to enable an EM skin within the frequency range of 2-18 GHz. The EM skin should enhance EM radiation while mitigating internal reflections for desirable frequency bands, and act as a scatterer or absorber of undesirable frequencies. The end of Phase I should produce several outcomes in the range of TRL 2-3. (1) Simulation study of the interactions and coupling between different RF components/subsystems in both planar and conformal aspects of an EM skin. (2) Determine how the chosen RF components affect the conformal, mechanical, thermal and environmental aspects of integrating the EM skin onto an airborne radome. (3) Full system simulation of the EM skin design on a representative Smart Radome surface including S-parameter performance and transmit/receive radiation performance of the EM skin. (4) A proof-of-concept prototype of a single unit cell of the EM skin with measured S-parameter and radiation performance. (5) The performer will provide a final report detailing the technology developed and its performance based on simulation and measured results.

PHASE II: The end of Phase II should produce several outcomes in the range of TRL 4. (1) Prototype a flat EM skin prototype based on the unit cell demonstrated in Phase I. The performer should measure the S-parameter and radiation performance of the EM skin. (2) Integrate a conformal EM skin prototype onto a representative curved Smart Radome surface. The performer should measure the S-parameter and radiation performance of the EM skin. (3) Determine the feasibility of integrating multiple layers of EM skins on top of one another either to enable two separate RF functionalities or to extend the bandwidth of the original EM skin design. Provide simulation results demonstrating the increased functionality of a multi-layer EM skin. (4) Prototype a flat EM skin unit cell incorporating the multi-layer configuration. The performer should measure the S-parameter and radiation performance of the EM skin. (5) The performer will provide a final report detailing the technology developed and its performance based on simulation and measured results.

PHASE III DUAL USE APPLICATIONS: At the end of the SBIR, the performer should be well positioned to transfer their EM skin and Smart Radome technology to both military and commercial applications. An electrically thin surface with built-in RF functionality would be of great interest to both military and commercial airborne applications. Replacing large radiating structures on the surface of an airborne platform has mitigating effects on drag reducing fuel consumption and lowering the overall cost of air flight. For military applications there is also the possibility to control out of band RF absorption. For SMART Munitions, the EM skin design would be easy to alter to provide geolocation and or RF sensing.

REFERENCES:

1. Nguyen, Q. and Zaghloul, A.I., 2020, July. Design of beam steering patch arrays using self-phased metasurface pixels. In 2020 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting (pp. 909-910).
2. Hodge, J.A., Nguyen, Q.M. and Zaghloul, A.I., 2020. Reflective beam steering of metasurface using circular inter-digitated self-phased pixels/cells. In 2020 General Assembly and Scientific Symposium of the International Union of Radio Science (pp. 1-4).
3. Hu, J., Bandyopadhyay, S., Liu, Y.H. and Shao, L.Y., 2021. A review on metasurface: from principle to smart metadevices. Frontiers in Physics, 8, p.586087.
4. Tahseen, H.U., Yang, L. and Zhou, X., 2021. Design of FSS-antenna-radome system for airborne and ground applications. IET Communications, 15(13), pp.1691-1699.

KEYWORDS: Electromagnetic (EM) skins, Smart Radome, metamaterials/metasurfaces, RF scattering

A23-004 TITLE: UAS Continuous Time Spectrum Situational Awareness

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 the Announcement. 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: “UAS Continuous Time Spectrum Situational Awareness,” research topic is to apply the advantages of continuous time signal processing over traditional DSP for advanced Spectrum Situational Awareness. Shannon’s sampling theorem [1] limits current spectrum situational awareness systems. Continuous time signal processing [2]-[5] is not limited by Shannon’s sampling theorem and provides significant advantages [2]-[6] and [9]-[14] over conventional digital signal processing.

DESCRIPTION: Advanced Spectrum Situational Awareness is required for improved threat detection and Future Tactical UAS applications. UAS swarms require accurate timing and position information for navigation and information fusion. A recent example showing the capabilities for swarm navigation and control was the opening display at the Tokyo 2020 Olympic Games [15]. A drone swarm created a rotating globe over Olympic stadium.

Advanced UAS sensor networks will provide data and sensor fusion for the future transparent battlefield [16]-[20]. Transparent Battlefield requires advanced spectrum situational awareness to enable first identification of threats and prevent adversaries from gaining an advantage. Warfighter Network needs to operate in a contested environment using advanced spectrum situational awareness and spectrum management. For commanders, spectrum situational awareness, transparent battlefield and warfighter networks provide a decisive decision and time advantage over peer adversaries.
“Continuous Time Spectrum Situational Awareness” research topic seeks to bring the advantages of continuous time systems over conventional digital systems to Spectrum Situational Awareness and swarm sensor and fusion networks.

Continuous time (CT) digital signal processing (DSP) is an emerging subfield of signal processing [2]-[6]. CT is asynchronous (no clock) like analog signal processing [2]-[6]. Continuous time [2]-[6] has the time domain properties of analog signal processing with the benefits of digital signal processing without discrete time limitations, quantization error, and Shannon sampling limitations [2]-[4]. Another benefit of CT systems is adaptive sampling. For a 2.5 second electrocardiogram (ECG) data set, a continuous-time, 32-level, level crossing ADC only requires 225 samples compared to 1250 samples for conventional digital signal processing. Fewer samples result in less data processing and lower energy. The medical community has recognized the benefits of improved accuracy and energy savings for processing ECG signals with CT systems [13]-[15].
Continuous time systems were first developed in the 1950’s for control system applications. In 1962, Inose, et al. [7] developed the asynchronous delta-sigma ($\Delta\Sigma$) analog-to-digital converter. A much more accurate $\Delta\Sigma$ demodulator technique was developed by Lazar and Tóth [8] in 2004. In 2003, Tsividis published his research work on the benefits of continuous time systems: no quantization error, no discrete time lag, and no frequency aliasing [2]-[3]. In a continuous time system, “quantization” occurs when the input signal exactly equals a threshold level, resulting in no inherent quantization error. Schell and Tsividis developed a 16-level (4-bit equivalent), continuous-time ADC with better than 100 dB signal-to-

noise-and distortion ratio (SNDR) using offline reconstruction [9]-[10]. Kurchuk et al. develop a GHz speed continuous time analog-to-digital converter in 2012 [11]. Jungwirth and Crowe [12] developed a continuous time pipeline analog-to-digital converter and continuous time software reconfigurable radio architecture.

Machine learning/artificial intelligence concepts can be applied to continuous time systems for signal analysis and signal processing. Neural networks based on analog signal processing concepts can be directly mapped into continuous time systems. Spiking neural networks are similar to continuous time systems. The continuous time properties (1) sample frequency is proportional to the slope of the input signal (compressive sensing) and (2) vector outputs (time stamp, and amplitude level) may be very beneficial for deep neural networks and signal processing.

This SBIR is a multidiscipline research effort, and researchers from several fields are required. Research team should include at a minimum researchers with significant experience in continuous time systems, spectrum estimation, signal processing, UAV swarms, sensor fusion, and machine learning/artificial intelligence. "Continuous Time Spectrum Situational Awareness," research topic is to apply the advantages of continuous time signal processing over traditional DSP for advanced Spectrum Situational Awareness. This effort is to support spectrum situational awareness for PEO Aviation, Long Range Precision Fires and Air and Missile Defense Army Modernization Priorities, the Microelectronics Technology Focus Area and long-term development areas of Transparent Battlefield, Warfighter Network, and Gaining Decision Advantage.

PHASE I: Conventional DSP systems are based on quantized, discrete time (digital). For the Phase I proposal, research team shall describe the feasibility (1)-(6) of developing a continuous time spectrum situational awareness system for UAS applications.
(1) multidiscipline research team
(2) advantages of continuous time spectrum situational awareness over conventional DSP.
(3) benefits of adaptive sampling and sample rate is proportional to the slope of the input signal
(4) conversion between continuous time and DSP.
(5) how machine learning/artificial intelligence, convolutional neural networks, etc. can be applied and take advantage of continuous time systems.
(6) propose a Future Tactical UAS application for continuous time spectrum situational awareness.
For the phase I effort, the offeror shall demonstrate the feasibility and performance benefits of continuous time systems for spectrum situational awareness. Offeror shall develop models, simulations, prototypes, etc. to determine technical feasibility (1)-(6) of developing continuous time spectrum situational awareness. Offer shall develop test cases for comparing CT-DSP to DSP.

PHASE II: Research team shall develop a Continuous Time Spectrum Situational Awareness System for Future Tactical UAS. Research team shall deliver a year 1 report and a year 2 report describing system architecture and test results. Offeror shall deliver to the government point of contact for test and evaluation: 1 prototype continuous time situational awareness system including all codes, software, etc. and licenses for all development tools to build and use the system. Research team shall provide 3 days of on-site training for the system.

PHASE III DUAL USE APPLICATIONS: Offer shall commercialize CTDSP technology for both government and commercial application spaces. The development of continuous-time digital signal processing will enable significant leap-ahead technology for signal processing to support communications, remote sensing, and control. These technologies offer potential benefits across several fields including communications, telecom and sensor networks for both military and civilian applications.

REFERENCES:

1. Wikipedia.org: “Nyquist–Shannon sampling theorem,” accessed 11/25/2022. https://en.wikipedia.org/wiki/Nyquist%E2%80%93Shannon_sampling_theorem
2. Y. Tsividis, “Continuous-time digital signal processing,” Electronics Letters 39(21), 1551 (2003).
3. Y. Tsividis, "Event-Driven Data Acquisition and Digital Signal Processing—A Tutorial", IEEE Transactions on Circuits and Systems—II: Express Briefs, Vol. 57, No. 8 (2010).
4. M. Kurchuk, Signal Encoding and Digital Signal Processing in Continuous Time, Dissertation, Columbia University, 2011.
5. F. Aeschlimann, E. Allier, L. Fesquet, and M. Renaudin, “Asynchronous FIR filters: towards a new digital processing chain,” in 10th International Symposium on Asynchronous Circuits and Systems, 2004. Proceedings., Apr. 2004, pp. 198–206, doi: 10.1109/ASYNC.2004.1299303.
6. Z. Zhao and A. Prodic, “Continuous-Time Digital Controller for High-Frequency DC-DC Converters,” IEEE Transactions on Power Electronics, vol. 23, no. 2, pp. 564–573, Mar. 2008.
7. H. Inose, Y. Yasuda, J. Murakami, "A Telemetering System by Code Manipulation – ΔΣ Modulation", IRE Trans on Space Electronics and Telemetry, Sep. 1962, pp. 204-209.
8. A. A. Lazar and L. T. Toth, "Time encoding and perfect recovery of bandlimited signals," 2003 IEEE International Conference on Acoustics, Speech, and Signal Processing, 2003. Proceedings. (ICASSP '03)., 2003, pp. VI-709, doi: 10.1109/ICASSP.2003.1201780.
9. C. Vezyrtzis and Y. Tsividis, “Processing of signals using level-crossing sampling,” Jun. 2009, pp. 2293–2296. doi:10.1109/ISCAS.2009.5118257
10. M. Kurchuk, C. Weltin-Wu, D. Morche, and Y. Tsividis, “Event-Driven GHz-Range Continuous-Time Digital Signal Processor with Activity-Dependent Power Dissipation”, IEEE Journal of Solid-State Circuits, vol. 47, no. 9, pp. 2164-2173, September 2012.
11. P. Jungwirth and W. Crowe, “CT Pipeline Level Crossing ADC and Continuous Time Software Reconfigurable Radio,” ARL Tech Report 9497, June 2022. https://apps.dtic.mil/sti/pdfs/AD1175477.pdf
12. A Antony, et al., Asynchronous Adaptive Threshold Level Crossing ADC for Wearable ECG Sensors. J Med Syst 43, 78 (2019). https://doi.org/10.1007/s10916-019-1186-8.
13. X. Zhang and Y. Lian, "A 300-mV 220-nW Event-Driven ADC With Real-Time QRS Detection for Wearable ECG Sensors," in IEEE Transactions on Biomedical Circuits and Systems, vol. 8, no. 6, pp. 834-843, Dec. 2014, doi: 10.1109/TBCAS.2013.2296942
14. T. Marisa, et al., “Pseudo asynchronous level crossing ADC for ECG signal acquisition,” IEEE Transactions on Biomedical Circuits and Systems 11 (2) (Apr. 2017) 267–278.
15. 2020 Olympics: “Earth-Shaped Drone Display Flies Above Tokyo 2020 Olympics Opening Ceremony,” accessed 12/7/2022. https://www.youtube.com/watch?v=rdmdULpAwoE
16. Y. Zhou, B. Rao and W. Wang, "UAV Swarm Intelligence: Recent Advances and Future Trends," in IEEE Access, vol. 8, pp. 183856-183878, 2020, doi: 10.1109/ACCESS.2020.3028865.
17. Z. Xiaoning, "Analysis of military application of UAV swarm technology," 2020 3rd International Conference on Unmanned Systems (ICUS), 2020, pp. 1200-1204, doi: 10.1109/ICUS50048.2020.9274974.
18. L. Giacomossi et al., "Autonomous and Collective Intelligence for UAV Swarm in Target Search Scenario," 2021 Latin American Robotics Symposium (LARS), 2021 Brazilian Symposium on Robotics (SBR), and 2021 Workshop on Robotics in Education (WRE), 2021, pp. 72-77, doi: 10.1109/LARS/SBR/WRE54079.2021.9605450.
19. M. R. Brust and B. M. Strimbu, "A networked swarm model for UAV deployment in the assessment of forest environments," 2015 IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 2015, pp. 1-6, doi: 10.1109/ISSNIP.2015.7106967.
20. S. James, R. Raheb and A. Hudak, "UAV Swarm Path Planning," 2020 Integrated Communications Navigation and Surveillance Conference (ICNS), 2020, pp. 2G3-1-2G3-12, doi: 10.1109/ICNS50378.2020.9223005.

KEYWORDS: Continuous time systems, Spectrum Situational Awareness, UAS

A23-005 TITLE: Open Source, High Assurance Hardware and Software Co-Design

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Microelectronics

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 the Announcement. 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: Open source hardware and software offer new opportunities for creating high assurance computing. Currently, seL 4 microkernel uses blocks of assembly language instructions for security primitives. Hardware primitives and software instructions can be added to the extensible RISC-V architecture to support seL 4 and other high assurance microkernels. Offer shall proposed a FPGA softcore RISC-V architecture to support and simplify the seL 4 high assurance microkernel.

DESCRIPTION: Current generation aviation systems were not developed with strong computer security requirements. Past cyber threats, [1]-[2], Spectre [3], Meltdown [4], current cyber treats, and future cyber treats need to be countered. Embedded system designs are typically based on commodity hardware optimized exclusively for speed – leading to critical cyber vulnerabilities that can have devastating effects on safety and mission effectiveness. This has also led to the unsustainable "Perimeter, Patch, Pray" Information Assurance strategy [5] that is simply impractical for fielded aviation and missile systems. De Clercq and Verbauwhede [6] have recommended more hardware based security over software. Hardware based operating systems concepts began in the 1970's [7]-[9]. The Intel iAPX 432 [10] pioneered protected objects in 1983. Nakano [11] developed the first practical hardware based operating system in 1995. Renesas released a commercial microcontroller [12] with a simple hardware based operating system in 2014. The RISC-V family of instruction set architectures was published open source in 2010 [13]. RISC-V was designed to be extendable. The high assurance microkernel, seL 4, was developed in 2009 [14]-[15].
We are interested in hardware/software co-design based on open source RISC-V and seL4 microkernel. The seL4 microkernel has blocks of assembly code that are not as rigorously proven as the C code for seL4. By extending RISC-V using hardware based operating system principles, a more streamlined and secure version of seL4 is possible. The offeror is asked to develop a RISC-V and seL4 high assurance FPGA softcore processor.

PHASE I: For the Phase I proposal, research team shall describe the feasibility (1)-(6) of developing a RISC-V softcore processor with hardware security primitives to simplify, and create a more secure seL4 microcontroller.
(1) describe multidiscipline research team
(2) advantages of developing a seL4 microkernel with fewer blocks of assembly code
(3) advantages seL4 microkernel with fewer blocks of assembly code for formal proof of correctness
(4) describe the design features of RISC-V that allow for implementing hardware security primitives to support high assurance microkernel's like seL4.
(5) describe how (2)-(4) can simplify machine proof-of-correctness.
(6) propose a Future of Vertical Lift application for RISC-V/seL4 co-design for "Open Source, High Assurance Hardware and Software Co-Design."
For the phase I effort, the offeror shall demonstrate the feasibility and performance benefits of RISC-

V/seL4 co-design for “Open Source, High Assurance Hardware and Software Co-Design.” Offeror shall develop models, simulations, prototypes, etc. to determine technical feasibility (1)-(6) of RISC-V/seL4 co-design for “Open Source, High Assurance Hardware and Software Co-Design.”

PHASE II: Research team shall develop a RISC-V/seL4 co-design for “Open Source, High Assurance Hardware and Software Co-Design” for Future of Vertical Lift application. Research team shall deliver a year 1 report and a year 2 report describing system architecture and test results. Offeror shall deliver to the government point of contact for test and evaluation: 2 prototype RISC-V/seL4 co-design for “Open Source, High Assurance Hardware and Software Co-Design” systems including all codes, software, etc. and licenses for all development tools to build and use the system. Research team shall provide 3 days of on-site training for the system.

PHASE III DUAL USE APPLICATIONS: Offer shall commercialize RISC-V/seL4 co-design for “Open Source, High Assurance Hardware and Software Co-Design” for both government and commercial application spaces. Offeror will develop and market high assurance system based on phase II development work and marketing plans from phase I and II. Offeror will integrate high assurance system into an Army Aviation or Missile subsystem currently under development or via technology refresh.

REFERENCES:

1. S. King, et al.: “SubVirt: implementing malware with virtual machines,” IEEE Symposium on Security and Privacy, pp. 1-14, 21-24 May 2006.
2. R. Fannon: An analysis of hardware-assisted virtual machine based rootkits, Thesis, Naval Postgraduate School, June 2014. calhoun.nps.edu/handle/10945/42621
3. P. Kocher, et al.: “Spectre Attacks: Exploiting Speculative Execution,” Cornell University Library, 3 Jan 2018. https://arxiv.org/pdf/1801.01203.pdf
4. M. Lipp, et al.: “Meltdown,” Cornel University Library, 3 Jan 2018. https://arxiv.org/pdf/1801.01207.pdf;
5. Darpa: “Baking Hack Resistance Directly into Hardware,” 4/10/2017. https://www.darpa.mil/news-events/2017-04-10.;
6. R. De Clercq and I. Verbauwhede: “A survey of Hardware-based Control Flow Integrity (CFI),” pp. 4-5, 31 Jul 2017. arxiv.org/ftp/arxiv/papers/1706/1706.07257.pdf
7. G. Sockut: "Firmware/hardware support for operating systems: principles and selected history," ACM SIGMICRO Newsletter, Volume 6 Issue 4, pp. 17 - 26, Dec. 1975. dl.acm.org/citation.cfm?id=1217198
8. G. Brown, et al.: “Operating system enhancement through firmware,” Proceedings of the 10th annual workshop on Microprogramming, ACM SIGMICRO Volume 8 Issue 3, pp. 110-133, Sept. 1977. https://dl.acm.org/citation.cfm?id=800102.803324
9. Higher Order Software: “Techniques for Operating System Machines,” Technical Report # 7, July 1977. www.dtic.mil/dtic/tr/fulltext/u2/772809.pdf
10. I. Witten, et al.: “An introduction to the architecture of the Intel iAPX 432,” IEEE Software & Microsystems, Vol. 2 , Issue 2, pp. 29-34, April 1983.
11. T. Nakano: “Hardware Implementation of a Real-time Operating System,” IEEE TRON Project International Symposium, Tokyo, Japan, pp. 34-42, 28 Nov – 2 Dec, 1995.
12. https://www.renesas.com/en-us/products/factory-automation/multi-protocol-communication/r-in32m3-hardware-rtos.html
13. A. Waterman: “Design of the RISC-V Instruction Set Architecture,” Thesis, EECS Department, University of California, Berkeley 2016. http://www2.eecs.berkeley.edu/Pubs/TechRpts/2016/EECS-2016-1.pdf
14. L4 microkernel family, accessed 12/7/22, https://en.wikipedia.org/wiki/L4_microkernel_family
15. G. Klein, et al.: "seL4: Formal verification of an OS kernel,” ACM Symposium on Operating System Principles, Big Sky, MT, USA October 2009,

16. V. Ushakov, et al.: "Trusted Hart for Mobile RISC-V Security," https://arxiv.org/pdf/2211.10299.pdf
17. R. Nair: "Evolution of Memory Architecture," IEEE Proceedings, Vol. 103, No. 8, pp. 1331 – 1345, August 2015.
18. P. Karger and R. Schnell: "Thirty Years Later: Lessons from the Multics Security Evaluation," IEEE Annual Computer Security Applications Conference, pp. 119-126, Las Vegas, NV, 9-13 Dec. 2002.
19. Tiwari, M., et al.: "Crafting a Usable Microkernel, Processor, and I/O System with Strict and Provable Information Flow Security," ACM Proceedings of the 38th annual international symposium on Computer architecture, pp. 189-200, San Jose, CA, 4-8 June 2011.
20. M. McCoyd, et al.: "Building a Hypervisor on a Formally Verifiable Protection Layer," https://people.eecs.berkeley.edu/~mmccoyd/papers/minvisor-hicss-12.pdf

KEYWORDS: RISC-V, seL 4, high assurance, softcore procressor, FPGA, computer architecture

A23-006 TITLE: Advanced III-V avalanche photodiode structures in the infrared

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 the Announcement. 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: Design and implement III-V based linear-mode infrared avalanche photodiodes suitable for ranging imagery.

DESCRIPTION: Active imaging systems all require the detection of reflected light, usually through an active source such as a laser. Additionally, commonly fielded single-point range finding technologies lack the capability to ensure that the range for the object of interest is being interrogated rather than an adjacent object in the scene. In this effort, we seek to develop III-V linear mode avalanche photodiodes which are capable of linear gain and short response times to enable detection and ranging of man-sized objects. Approaches compatible with leveraging large substrates and existing mature commercial foundry services are highly preferred.

PHASE I: Design and model III-V APD detector structures compatible with GaSb or GaAs substrates and capable of linear gains with short response times in the infrared. Determine growth process that includes any experimental parametric variations for fabrication. Proposers intending to grow initial test structures and perform preliminary characterization in Phase I will be rated favorably. Develop experimental plan for achieving anticipate Phase II program goals.

PHASE II: Execute growth, characterization, and fabrication plans developed during the Phase I program. Deliver growth recipe to commercial growth foundry and determine efficacy of growth via wafer level characterization as necessary. Fabricate test chips or large area devices suitable for cryogenic testing and measure sensor dark current, spectral characteristics, and quantum efficiency. Characterize gain of device as function of applied bias and show gain-normalized dark current levels. Characterize minimum detectable pulse energy using test structures or mini-arrays. By the conclusion of the Phase II program, deliver a test report and test structures to the Army for characterization of pulse detection.

PHASE III DUAL USE APPLICATIONS: Continue to mature the technologies developed in Phase II for potential dual-use applications that require ranging. Continue incremental improvement of detector structures and increase array format to sizes suitable for imaging. Investigate options for ROIC integration.

REFERENCES:

21. Tan, Chee Leong, and Hooman Mohseni. "Emerging technologies for high performance infrared detectors." Nanophotonics 7.1 (2018): 169-197.
22. Shrestha, Ajay, and Ausif Mahmood. "Review of deep learning algorithms and architectures." IEEE access 7 (2019): 53040-53065.
23. Gach, Jean-Luc. "Photon counting in the infrared with e-APD devices." High Energy, Optical, and Infrared Detectors for Astronomy VIII. Vol. 10709. SPIE, 2018.

KEYWORDS: avalanche photodiode (APD), pulse detection, infrared, III-V material

A23-007 TITLE: Multi-Modal Synthetic Data Corpus to Support Machine Intelligence Development

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Trusted AI and Autonomy

OBJECTIVE:
1. Synthetically create a multi-modal data corpus that can be used to train Artificial Intelligence/Machine Learning (AI/ML) Algorithms to support multi-Intelligence (multi-INT) data fusion and machine intelligence.
2. Develop a scenario-based tool that enables the Army to create an environment that can develop and test future multi-modal AI/ML capabilities

DESCRIPTION: Multi-Modal data includes text, images, sounds, etc. Having a corpus of synthetic multi-modal data allows the Army to fuse this data together and rapidly generate higher preforming AI/ML algorithms. Creating an Army owned environment that can develop and test future AI/ML capabilities with a focus on multi-INT data fusion and machine intelligence. This environment should be able use the synthetic data to simulate different scenarios for AL/ML training and validation. Some scenarios may include situations where we need to distribute AI to edge deceives.

PHASE I: Conduct research and complete the initial design of the scenario-based tool for testing and developing AI/ML capabilities with a baseline dataset for the multi-modal synthetic data corpus.

PHASE II: Creation of the scenario-based prototype tool for testing and developing AI/ML capabilities along with the multi-modal synthetic data corpus that can train high fidelity AI/ML algorithms.

PHASE III DUAL USE APPLICATIONS: Maturing the prototype into a planned operational system which can be demonstrated in the operational environment.

REFERENCES:

1. Microsoft https://www.microsoft.com/en-us/ai/ai-lab-synthetic-data-showcase
2. TensorFlow https://www.tensorflow.org/tensorboard\
3. Penn State University SYNCOIN Data set https://www.eng.buffalo.edu/~nagi/MURI/MURI/PDF%20Presentations/2%20-%20Jake%20-%20Problem%20Domain-SYNCOIN%20Data%20Set.pdf; https://www.anylogic.com/features/artificial-intelligence/

KEYWORDS: Data Fusion, Multi-Modal Data, Multi-INT Data, Machine Intelligence, Artificial Intelligence/ Machine Learning (AI/ML), Testing and Validation

A23-008 TITLE: Wideband RF Sensing Algorithms for Detection of Priority Ground RF-Enabled Threats

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software, Trusted AI and Autonomy

OBJECTIVE: Leveraging emergent combinations of commercially available high-rate Analog-to-Digital Converters (ADCs) and advanced Field Programmable Gate Arrays (FPGAs) to detect a broad spectrum of priority Radio Frequency (RF)-enabled threats.

DESCRIPTION: This effort explores novel applications of new, state of the art Commercial Off the Shelf (COTS) ADCs tightly integrated with advanced FPGAs providing revolutionary increases in wideband direct digital Radio Frequency (RF) sampling. Rapidly changing threat environment with a multitude of signals, both threat and non-threat, in close proximity and covering an ever-increasing swath of spectrum, is an ever-present challenge. This presents the difficult task of assessing and identifying a wide variety of signal types accurately and quickly across an extremely wide range of frequencies. Additionally, as systems are forced to address an increased number of threats concurrently, false detections can compromise protection, requiring identification algorithms to be more precise. With the increase in spectrum data that RF systems now need to ingest as a result of advances in state-of-the-art ADC coupled RF FPGAs, systems are further in danger of wasting these gains through inefficient detection and identification techniques.

These emerging COTS ADCs will enable new algorithms for wideband threat detection that has the potential to increase the efficiency and efficacy of future next gen systems. This is extremely important for ground platforms face a complex cluttered environment and are increasingly hindered by platform space and power constraints. Systems in the future will also need to identify and characterize unknown threats, these enhanced algorithms will provide rapid detection and better effectiveness at the tactical edge. Decreasing false detections and misclassifications reduce unnecessary RF emissions and reduce output power and increase systems interoperability. All these factors require an innovative set of detection and identification algorithms capable of leveraging advanced RF components to provide accurate and efficient threat characterization across an extremely wideband of RF frequencies.

PHASE I: Identify novel algorithms and techniques for threat/signal identification enabled by wideband COTS hardware to detect representative Radio Frequency (RF) enabled threats targeting ground platforms. Use representative class of threats to define an extendable proof of concept, algorithm (or suite of algorithms) for wideband threat identification on identified COTS hardware. Define requirements for algorithm and validate method/framework for identifying and characterizing threats. Measure performance of algorithm against such metrics as speed, accuracy, and rate of false characterization, as well as proficiency in successfully characterizing out of library threats.

PHASE II: Implement prototype algorithm developed in Phase I and an extended to include additional classes of threats. Demonstrate generalized identification algorithms for all types of RF-threats to ground platforms within a digital M&S environment provide report documenting findings. Additional class(es) of threats will be assessed based on how well it demonstrates an extension of the base algorithms, as well as how different the class(es) of threat(s) is(are) from the original class used in Phase I. Algorithms will be assessed based on effectiveness criteria mentioned above, as well as ease and speed of algorithm retraining. Identify exemplar threat and demonstrate and test algorithms in a Hardware in the Loop (HITL) environment.

PHASE III DUAL USE APPLICATIONS: Implement and test algorithms from Phase II on wideband representative hardware and demonstrate in relevant open-air environment. Demonstrate performance gains that superior detection and identification algorithms can provide on hardware.

REFERENCES:

4. https://www.turing.ac.uk/research/interest-groups/machine-learning-radio-frequency-applications
5. https://ieeexplore.ieee.org/abstract/document/8879545
6. https://ieeexplore.ieee.org/abstract/document/8913640
7. https://ieeexplore.ieee.org/abstract/document/8988509

KEYWORDS: Machine Learning, Ground Platforms, Threat Identification, Survivability

A23-009 TITLE: Zero Trust Identity

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

OBJECTIVE: Determine the level of risk when a person uses a personal device to access Army resources (i.e., Bring Your Own Device (BYOD)) in accordance with Zero Trust principles

DESCRIPTION: As per NIST 800-207, one of the basic tenets of Zero Trust is “Access to resources is determined by dynamic policy—including the observable state of client identity, application/service, and the requesting asset—and may include other behavioral and environmental attributes”. When the requesting asset is an approved managed device, the security and trustworthiness of the device can be determined using the one of the many agents that are already installed on the asset and are used to control the asset configuration. In a Bring Your Own Device (BYOD) scenario the device is not managed by the Army and the state and trustworthiness of the asset is unknown. Additionally, people are highly reluctant to install monitoring software (e.g., agents) on their personal device to allow the Army to determine the state of the device. Without an understanding of the state of the device, the device is considered untrustworthy and it is prevented from accessing Army resources. This results in the Army having to purchase, provide, manage and maintain equipment (e.g., laptops, mobile phones etc.) for people to access Army resources. This cost grows very large when considering the large quantity and variety of users, such as active-duty military, guard, reserves, civilians and contractors that utilize Army resources. The purpose of this SBIR is to research and develop innovative ways to determine the trustworthiness of a personal device, without requiring software to be installed on the device. A solution to this problem would enable any user to utilize personal devices, such as mobile devices and personal computers, to access Army resources, while still providing the Army with a dynamic risk analysis that help protect Army resources from being accessed from untrustworthy devices.

PHASE I: Determine the feasibility of the proposed solution. The solution should describe in detail the approach to be used for determining the trustworthiness of the device without installing software on the device. The solution should also describe the technical challenges, the risks and how they will be mitigated and any dependencies that are required for the solution to work. The approach should be designed with open architecture and industry standards and protocols in mind.

PHASE II: Develop the solution outlined in Phase I. A demonstration of the solution determining the trustworthiness of a BYOD (specific device information will be provided after award). The demonstration should include the ability for the observers to determine how the level of trustworthiness for a given device was measured (e.g., what specific device factors were used to determine the level of trustworthiness of the device, any configuration data used in the decision and how that data was mapped to a level of trustworthiness etc.).

PHASE III DUAL USE APPLICATIONS: Expand the solution to enable determining trust on additional devices (examples information will be provided after award). The demonstration in Phase II is expected to utilize a small number of trust factors, so in Phase III the solution should be enhanced to include additional trust factors for the types of devices supported in Phase II.

REFERENCES:

1. “NIST Special Publication 800-207 Zero Trust Architecture” https://csrc.nist.gov/publications/detail/sp/800-207/final
2. “DOD Zero Trust Reference Architecture v2.0” https://dodcio.defense.gov/Portals/0/Documents/Library/(U)ZT_RA_v2.0(U)_Sep22.pdf

KEYWORDS: ZERO TRUST, DEVICE, RISK, TRUST, BYOD, CYBERSECURITY

A23-010 TITLE: Open Multi-Sensor Counter Unmanned Aerial Systems (C-UAS) Software System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

OBJECTIVE: Develop a solution that addresses the design of a multi-sensor counter unmanned aerial system (cUAS) capability utilizing an open software platform.

DESCRIPTION: A counter unmanned aerial system (C-UAS) that utilizes multiple sensors would have the ability to detect and track unmanned aerial vehicles (UAVs) using a variety of methods while minimizing nuisance detections to near zero. This may include radar, infrared, electro-optical, acoustic, or other sensors. The system would then use this information to identify and classify the UAV, and ultimately neutralize or redirect it if necessary. The use of multiple sensors would also help to reduce the likelihood of false alarms and improve the overall accuracy of the system.
Additionally, utilizing an open platform for counter unmanned aerial systems (C-UAS) is important for several reasons.

First, an open platform allows for the integration of multiple sensors and technologies.
Second, an open platform enables third-party developers to create and integrate new capabilities, which can help to keep the system up to date with the latest technologies and threats.
Third, an open platform can also lower the system's cost and increase its flexibility.
Finally, an open platform can foster innovation and collaboration within the C-UAS industry, which can lead to new technologies and capabilities that can benefit everyone.

PHASE I: The purpose of this Phase I SBIR is to provide a white paper that addresses the design of an open platform multi-sensor counter unmanned aerial system (C-UAS) capabilities system. The white paper should contain the following key elements:
1. An overview of the C-UAS problem: The white paper should provide an overview of the current C-UAS threat landscape and the challenges that organizations face in detecting and neutralizing UAVs.
2. A description of the multi-sensor approach: The white paper should describe the advantages of using multiple sensors to detect and track UAVs, including how this approach can improve the system's overall performance and effectiveness.
3. An explanation of the different sensors and technologies used: The white paper should provide a detailed description of the different passive sensors and technologies that should be used and integrated into the system, including passive radar, infrared, electro-optical, acoustic, or other sensors and effectors. It should also explain how these sensors and technologies work together while minimizing false positives and performing all operations prior to defeating a UAS without user input in a variety of environments, ranging from urban cities and dense forest to remote desert environments, etc. Additional details will be provided to firm once selected.
4. An analysis of system performance: The white paper should provide an analysis of the system's anticipated performance in different and varying environments utilizing a variety of sensors and effectors. Additional details will be provided to firm once selected.
5. A description of the system's capabilities: The white paper should describe the system's capabilities, including its ability to detect and track UAVs, its ability to neutralize or redirect UAVs, and its ability to integrate with other existing systems. Additional details will be provided to firm once selected.
6. A discussion of future developments: The white paper should discuss future developments and enhancements that can be made to the system by third-party developers, including adding new sensors, algorithms, and software updates, etc.

PHASE II: Develop and demonstrate the solution to achieve the capabilities outlined in Phase I by developing the software for an open multi sensor c-UAS system that achieves the capabilities outlined in

the whitepaper. Host the software in a government owned full DEVSECOPS environment that allows for the benefits of Open Systems development to be utilized. Integrate and fuse many disparate sensors and effectors of varying quality and types - Additional details will be provided to firm once selected.
Integrate the outputs of the open system into existing systems. Additional details will be provided to firm once selected.
Ensure third party developers can build upon the work from this open system with other associated source code repositories they may develop.

PHASE III DUAL USE APPLICATIONS: Expand the capabilities of the solution to allow for integration of additional sensors into the open architecture. Implement enhanced SWAP capabilities and add additional algorithms that optimize usage of the c-UAS system to operate without user input. Additional details will be provided to firm once selected.

REFERENCES:

1. J. Wang, Y. Liu and H. Song, "Counter-Unmanned Aircraft System(s) (C-UAS): State of the Art, Challenges, and Future Trends," in IEEE Aerospace and Electronic Systems Magazine, vol. 36, no. 3, pp. 4-29, 1 March 2021, doi: 10.1109/MAES.2020.3015537.
2. S. R. Ganti and Y. Kim, "Implementation of detection and tracking mechanism for small UAS," 2016 International Conference on Unmanned Aircraft Systems (ICUAS), Arlington, VA, USA, 2016, pp. 1254-1260, doi: 10.1109/ICUAS.2016.7502513.
3. D. Spinellis, "Git," in IEEE Software, vol. 29, no. 3, pp. 100-101, May-June 2012, doi: 10.1109/MS.2012.61. Ram, K. Git can facilitate greater reproducibility and increased transparency in science. Source Code Biol Med 8, 7 (2013). https://doi.org/10.1186/1751-0473-8-7

KEYWORDS: Counter-Unmanned Aircraft System (CUAS), Multi-Sensor Fusion, DEVSECOPS

A23-011 TITLE: Operations in Degraded Visual Environments using Millimeter Wave Imagery

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sesning and Cyber

OBJECTIVE: Develop a millimeter wave imaging system capable of seeing through Degraded Visual Environments (DVE) to address current needs for DVE mitigation within the Defense community.

DESCRIPTION: Degraded Visual Environments (DVE) present significant challenges to tactical operations due to lack of situational awareness, which can lead to mission failure and loss of life. Such environments include low light, fog, dust, rain, snow, and other visual obscurants. Imaging in the millimeter wave region of the spectrum has demonstrated great utility for the ability to see through such obscurants with low attenuation, thereby providing navigational and operational cues and consequently a unilateral tactical advantage. [1] Millimeter wave imaging technology has furthermore found application in screening for contraband including person-borne weapons and improvised explosives hidden under clothing. [2] Nonetheless, current millimeter wave imaging technology remains complex, expensive, and high size, weight and power (SWaP); significant reductions in these parameters are required to facilitate greater deployment opportunities and open new applications and markets. To this end, increased leverage of commercial off-the-shelf (COTS) components is needed. The recent proliferation of collision avoidance radar systems within the automotive industry has created a huge market for millimeter wave components, bringing production to scale and driving down prices. Such radar systems are generally able to warn that objects are within a certain detection range, but do not currently identify these objects nor provide intuitive imagery of them. A system consisting of small arrays of these automotive radars in conjunction with rapidly developing artificial intelligence and machine learning technologies creates great potential for low SWaP imaging solutions to DVE with unprecedented capabilities and price points. [3] Leveraging of these recently developed low-cost systems could address current needs for DVE mitigation within the Defense community.

PHASE I: Define a system concept and perform a feasibility study. The system should be able to visualize through common degraded visual environments such as low light, fog, dust, rain, snow, and other visual obscurants The system should run at video rate (24 frames/sec or better). The system should have sufficient resolutions to be able to detect and resolve a human shape from a distance of 30 meters or greater.

PHASE II: Build a hardware prototype and demonstrate DVE mitigation capability. Construct and demonstrate a working prototype imaging system using the design developed in Phase I. Demonstrate video rate imaging of threats from a distance of 30 meters or greater. Develop artificial intelligence and machine learning technologies to support rapid and robust detection of threats in environment with significantly visual degradation. Deliver the working prototype to the government for further testing.

PHASE III DUAL USE APPLICATIONS: Further research and development during Phase III efforts will be directed toward refining the final deployable equipment and procedures. Design modifications based on results from tests conducted during Phase III will be incorporated into the system. Manufacturability specific to Army Concept of Operations (CONOPS) and end-user requirements will be examined. The development of a low-cost solution to imaging in the millimeter wave region has the potential to provide significant benefits to numerous programs within the DOD and will also have application in commercial markets.

REFERENCES:
1. R. Appleby, D. A. Robertson, and D. Wikner, “Millimeter wave imaging: a historical review,” presented at the SPIE Defense + Security, Anaheim, California, United States, May 2017, p. 1018902. doi: 10.1117/12.2262476.

2. S. Yeom, D.-S. Lee, Y. Jang, M.-K. Lee, and S.-W. Jung, “Real-time concealed-object detection and recognition with passive millimeter wave imaging,” Opt. Express, vol. 20, no. 9, p. 9371, Apr. 2012, doi: 10.1364/OE.20.009371.
3. F. J. Abdu, Y. Zhang, M. Fu, Y. Li, and Z. Deng, “Application of Deep Learning on Millimeter-Wave Radar Signals: A Review,” Sensors, vol. 21, no. 6, p. 1951, Mar. 2021, doi: 10.3390/s21061951.
4. Paul. H. Lehmann, Michael Jones, and Marc Höfinger, "Impact of turbulence and degraded visual environment on pilot workload." CEAS Aeronautical Journal, vol 8, no. 3, pp. 413-428, 2017

KEYWORDS: Degraded Visual Environment, DVE, Millimeter Wave, Automotive Radar, Computer Vision, Machine Learning.

A23-012 TITLE: Adapting commercial technologies to deliver the Modular Attributable Sensor System (MASS), an array of AI-enabled sensor nodes interoperable with the Unified Network

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Ingrated Network Systems of Systems

OBJECTIVE: Develop and validate a software tool compatible with various hardware systems that will allow military end users to analyze, store, and share photo and video data. The system will allow military customers to tap real-time data sources from IP-based CCTV, mobile ISR systems and unattended sensors (e.g. camera traps, small tactical grids) in a unified interface. Sample use cases include physical security, fire/smoke surveillance, firearm detection, and wildlife surveys on training lands. The goal of the project is to develop a specific use case, contributing to the Army Network modernization priority.

DESCRIPTION: Today, large Army installations rely on sparse, labor-intensive patrols for security, training operations, compliance, and other routine operational tasks. As a result, these areas suffer from high operational costs, slow response times, and frequent disruptions to training activities, directly impacting military readiness.

Persistent, AI-based surveillance can modernize many of these routine tasks when deployed at scale across these areas to free Army personnel to focus on the mission, reduce operational costs, and improve response times for critical security, compliance, and operational events (e.g. unknown vehicle intrusion in restricted areas, vandalism of government property, disease spreading among a population of a federally listed species).

Successful solutions should provide Army Network compatibility, have scalability for large quantities of data, offer web-based command and control interface, and allow forward and backward integration of various sensor systems through zero-trust APIs. The solution should be adaptable across various use cases in line with Army installation of the future priorities. Sensor pods that incorporate renewable technology (e.g. solar power) have the potential to contribute to the Energy Independence and Security Act of 2007 priorities, while offering improved installation resiliency.

PHASE I: Perform lab testing and customer discovery of a system that will allow military end users to analyze video and photo data. The system should be compatible with the Army Network and provide operational benefits (e.g., time savings) in a specific use case. Quantify the accuracy of detection for different events. Determine how artificial intelligence algorithms can be incorporated into DoD and commercial operations. The false positive rate and false negative rate should reach < 90%.

PHASE II: Develop a new system or adapt a commercial product that will allow military end users to use AI approaches to categorize imagery and other related data. Test the system in real-world use with a partner installation identified by the TPOC. The false positive rate and false negative rate should reach < 95%. Reduce the time for photo categorization by 50+% and improve data availability.

PHASE III DUAL USE APPLICATIONS: The project has broad applicability across all military branches/installations and private sector. The outcome of the project will be a state of art system reflecting learnings from military, commercial and open-source communities. The benefits of the project will include (1) Time savings through the use of automation and collaboration tools, (2) Faster detection speed for operational trends and adaptive

REFERENCES:

1. U.S. Army Engineer Research and Development Center. (n.d.). Virtual Testbed for Installation Mission Effectiveness Archives –. Power of ERDC Podcast. https://poweroferdcpodcast.org/tag/virtual-testbed-for-installation-mission-effectiveness/
2. Microsoft. (2020, November 22). Microsoft Rocket for Live Video Analytics. Microsoft Research. https://www.microsoft.com/en-us/research/project/live-video-analytics/
3. What Is Amazon Rekognition? (1:42). (n.d.). Amazon Web Services, Inc. https://aws.amazon.com/rekognition/
4. Army TM 11-6675-379-10c. "Operator's Manual for Instrument Set, Reconnaissance and Surveying (ENFIRE) AN/TKQ-5 (NSN: 6675-01-559-6558)," Army Publishing Directorate, 2009.

KEYWORDS: artificial intelligence, unified network, security surveillance, sensor agnostic, persistent power management, renewable energy, climate resilience, natural and cultural resource management

A23-013 TITLE: Real-Time Analytics for Engineer Reconnaissance

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software

OBJECTIVE: To develop a software solution to translate ground-based full-motion video (FMV) data collected by Engineer reconnaissance assets into a digital product that can be manipulated and analyzed to answer intelligence requirements and inform command decisions. This tool will assist Engineers in exploiting the previously underutilized resource of ground-based FMV data, providing engineers and decision-makers with a visualization of obstacles and mobility corridors.

DESCRIPTION: This topic focuses the development of analytical tools for processing tactical sensor data to automate engineer reconnaissance functions. Army engineers possess capabilities to acquire reconnaissance data from a suite of sensors housed in the Instrument Set, Reconnaissance and Surveying Toolkit (ENFIRE). A Microsoft LifeCam video camera and Ricoh G800SE digital camera capture imagery and focal length augmented by laser range finder distance measurements. Currently, Soldiers capture video imagery as reconnaissance teams traverse areas of interest and then transport and offload data for post-processing. Our effort will decrease collection and exploitation times thereby collaterally benefitting delivery of intelligence necessary for command decisions.

PHASE I: Determine the technical feasibility of ingesting, processing, and displaying imagery from multiple ground sensors focusing on a single geographic objective, i.e. roads, bridges, tunnels. During Phase 1, formats and resolution of data provided by current sensors within the ENFIRE system should be reviewed and assessed. Some field testing is anticipated to verify that the technical approach is achievable for further development in Phase 2. Deliver a report documenting the initial research activities under Phase 1 to document the initial concept.

PHASE II: Implement the Phase I architecture on ENFIRE edge computing devices. Demonstrate the prototype capability to generate digital products of specific portions of routes, such as bridges and tunnels. Demonstrate in-app essential analytical tools, including dimensions of obstacles. Demonstrate capabilities potential for integration into existing ENFIRE hardware and workflows. Army Engineers shall conduct the final demonstration in a field environment with a relevant tactical scenario, such as a route reconnaissance mission.

PHASE III DUAL USE APPLICATIONS: The work has a broad range of applications for military reconnaissance and mission planning. The studies conducted under Phase 1 and 2 will be novel and useful in establishing a framework for expediting the process of analyzing engineer reconnaissance data. This work would validate and integrate outcomes of the research into the ENFIRE system. Additional applications of this work would exist for any agency performing disaster recovery missions or other functions requiring actionable information on infrastructure.

REFERENCES:
1. U.S. Army Engineer Research and Development Center. (n.d.). Virtual Testbed for Installation Mission Effectiveness Archives –. Power of ERDC Podcast. https://poweroferdcpodcast.org/tag/virtual-testbed-for-installation-mission-effectiveness/
2. Army TM 11-6675-379-10c. "Operator’s Manual for Instrument Set, Reconnaissance and Surveying (ENFIRE) AN/TKQ-5 (NSN: 6675-01-559-6558)," Army Publishing Directorate, 2009.
3. Wang, K.C.P., “Elements of automated survey of pavements and a 3D methodology," in Journal of Mondern Transportation, Vol. 19, No.1, 2011.

4. Mendez, O., Hadfield, S., Pugeault, N., and Bowden, R., "Taking the Scenic Route to 3D: Optimising Reconstruction from Moving Cameras," Proceedings from the International Conference on Computer Vision, 2017.

KEYWORDS: reconnaissance, artificial intelligence, survey, infrastructure, imagery

A23-014 TITLE: Persistent Intelligence, Surveillance, and Reconnaissance via Perching Unmanned Air Vehicles

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 the Announcement. 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: Perform preliminary design of autonomous, robust, and versatile perching capabilities with an unmanned air vehicle to enable persistent intelligence, surveillance, and reconnaissance (ISR).

DESCRIPTION: Small unmanned air vehicles (UAVs) have demonstrated the ability to autonomously plan trajectories that allow them to maneuver through tight spaces [1], precisely land on moving platforms [2], and even perch onto various targets in the environment (poles, rods, cables, walls, tree branches, etc.) [3]. Perching has been accomplished through grippers [4], magnets [5], adhesives [6, 7], modular/actuated landing gears [8], and metamorphic frames [9]. UAVs have demonstrated perching on targets with horizontal [10], vertical [11], inclined [12], and even inverted [13] orientations. Perching capabilities have been largely demonstrated in laboratory settings with the assistance of indoor cameras systems that provide accurate UAV state information to assist in perching on the desired target. The limited outdoor demonstrations of perching capabilities could be combined with recent advances in vision-based navigation algorithms to enable autonomous perching solely using onboard sensors [14]. Perching can offer significantly reduced energy usage compared to the power required for hovering, but energy expenditure may not be zero. Novel methods to recharge UAVs through powerlines [15] and photovoltaic cells [16] could be used to extend perching endurance for persistent ISR.

The goal of this SBIR is to review the state-of-the-art and the capabilities of existing systems and then perform a thorough preliminary design of a system that would be capable of performing the persistent intelligence, surveillance, and reconnaissance mission. The preliminary design should include, at a minimum, coverage of the platform, perching method/mechanism/algorithms, sensor payload(s), and recharging capability with respect to anticipated energy demand. The design should be able to identify a target perch location using onboard sensors and then autonomously navigate towards and robustly perch onto the target in an orientation that allows it to direct onboard sensors at a desired target location to provide persistent ISR.

PHASE I: Detailed design and data package fully describing the candidate platform, perching method/mechanism/algorithms, sensor payload(s), and recharging capability will be submitted. The data package should include detailed description of modeling, analysis, and simulation activity used to determine that the system will be capable of satisfying mission requirements.

PHASE II: Required Phase II deliverables include a demonstration with a prototype UAV autonomously perching onto realistic environments and providing ISR on a target location using multispectral sensors. The UAV shall be able to robustly perch onto the target and remain perched in wind conditions gusting up to 10 knots. The UAV must be able to remain perched without the use of propulsion and increase the charge on the vehicle's battery by extracting energy from the environment. A report detailing the UAV's dynamic response, flight control system, autonomy, perching mechanism and maneuver, and test results will be submitted.

PHASE III DUAL USE APPLICATIONS: This capability could be used in military applications to deploy UAVs into contested areas for ISR while perching for concealment and endurance.

REFERENCES:

1. Mellinger, D., Michael, N., Kumar, V., "Trajectory generation and control for precise aggressive maneuvers with quadrotors," The International Journal of Robotics Research, January 2012.
2. Tzoumanikas, D., Li, W., Grimm, M., Zhang, K., Kovač, M., & Leutenegger, S., "Fully autonomous MAV flight and landing on a moving target using visual-inertial estimation and model-predictive control," Journal of Field Robotics, Vol. 36, Issue 1, October 2018.
3. Meng, J., Buzzatto, J., Liu, Y., Liarokapis, M., "On Aerial Robots with Grasping and Perching Capabilities: A Comprehensive Review," Frontiers in Robotics and AI, Vol. 8, 2022.
4. Hsaio, H., Sun, J., Zhang, H., Zhao, J., "A Mechanically Intelligent and Passive Gripper for Aerial Perching and Grasping," IEEE/ASME Transactions on Mechatronics, Vol. 27, No. 6, December 2022.
5. Fiaz, U.A., Abdelkader, M., Shamma, J.S., "An Intelligent Gripper Design for Autonomous Aerial Transport with Passive Magnetic Grasping and Dual-Impulsive Release," IEEE/ASME International Conference on Advanced Intelligent Mechatronics, 2018.
6. Graule, M. A., Chirarattananon, P., Fuller, S. B., Jafferis, N. T., Ma, K. Y., Spenko, M., Kornbluh, R., Wood, R. J., "Perching and Takeoff of a Robotic Insect on Overhangs Using Switchable Electrostatic Adhesion," Science, Vol 352 Issue 6288 pp. 978-982, May 2016.
7. Daler, L., Klaptocz, A., Briod, A., Sitti M., Floreano, D., "A Perching Mechanism for Flying Robots Using a Fibre-Based Adhesive," IEEE International Conference on Robotics and Automation, Karlsruhe, Germany, May 2013.
8. Hang, K., Lyu, X., Song, H., Stork, J., Dollar, A., Kragic, D., Zhang, F., "Perching and resting—A paradigm for UAV maneuvering with modularized landing gears," Science Robotics, Vol. 4 Issue 28, March 2019.
9. Zheng, P., Xiao, F., Nguyen, P.H., Farinha, A., Kovac, M., Metamorphic aerial robot capable of mid-air shape morphing for rapid perching. Scientific Reports 13, Article 1297, January 2023.
10. Zhang, H., Lerner, E., Cheng, B., Zhao, J., "Compliant Bistable Grippers Enable Passive Perching for Micro Aerial Vehicles," IEEE/ASME Transactions on Mechatronics, Vol. 26, No. 5, October 2021.
11. Mellinger, D., Shomin, M., Kumar, V., "Control of Quadrotors for Robust Perching and Landing," International Powered Lift Conference, Philadelphia, PA, October 2010.
12. Thomas, J., Pope, M., Giuseppe, L., Hawkes, E.W., Estrada, M.A., Jiang, H., Cutkosky, M.R., Kumar, V., "Aggressive Flight with Quadrotors for Perching on Inclined Surfaces," Journal of Mechanisms and Robotics, December 2015.
13. Habas, B., AlAttar, B., Davis, B., Langelaan, J.W., Cheng, B., "Optimal Inverted Landing in a Small Aerial Robot with Varied Approach Velocities and Landing Gear Designs," International Conference on Robotics and Automation, Philadelphia, PA, May 2022.
14. Mao, J., Nogar, S., Kroninger, C., Giuseppe, L., "Robust Active Visual Perching with Quadrotors on Inclined Surfaces," IEEE Transactions on Robotics, February 2023.
15. Ben-Moshe, B., "Power Line Charging Mechanism for Drones," Drones, October 2021.
16. Elkunchwar, N., Chandrasekaran, S., Iyer, V., Fuller, S.B., "Toward battery-free flight: Duty cycled recharging of small drones," IEEE/RSJ International Conference on Intelligent Robots and Systems, Prague, Czech Republic, September 2021.

KEYWORDS: UAV, multirotor, perching, autonomy, recharge, intelligence, surveillance, reconnaissance

VERSION 7

DEPARTMENT OF THE NAVY (DON)
23.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to topics:**
    - **N232-079 through N232-116**
- **The information provided in the DON Proposal Submission Instructions document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **DON Phase I Technical Volume (Volume 2) page limit is not to exceed 10 pages.**
- **Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposing small business concerns are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.**
- Phase I Technical Volume (Volume 2) and Supporting Documents (Volume 5) templates, specific to DON topics, are available at https://www.navysbir.com/links_forms.htm.
- The DON provides notice that Basic Ordering Agreements (BOAs) may be used for Phase I awards, and BOAs or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- This BAA is issued under regulations set forth in Federal Acquisition Regulation (FAR) 35.016 and awards will be made under "other competitive procedures". The policies and procedures of FAR Subpart 15.3 shall not apply to this BAA, except as specifically referenced in it. All procedures are at the sole discretion of the Government as set forth in this BAA. Submission of a proposal in response to this BAA constitutes the express acknowledgement to that effect by the proposing small business concern.

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information on DON's mission can be found on the DON website at www.navy.mil.

Digital Engineering. DON desires the ability to design, integrate, and test naval products by using authoritative sources of system data, which enables the creation of virtual or digital models for learning and experimentation, to fully integrate and test actual systems or components of systems across disciplines to support lifecycle activities from concept through disposal. To achieve this, digital engineering innovations will be sought in topics with titles leading with DIGITAL ENGINEERING.

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	When	Contact Information
Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

TABLE 2: DON SYSTEMS COMMANDS (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N232-079 to N232-082	Mr. Jeffrey Kent	Marine Corps Systems Command (MCSC)	sbir.admin@usmc.mil
N232-083 to N232-099	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N232-100 to N232-101	Mr. Jason Schroepfer	Naval Sea Systems Command (NAVSEA)	NSSC_SBIR.fct@navy.mil
N232-102 to N232-111	Ms. Lore-Anne Ponirakis	Office of Naval Research (ONR)	usn.pentagon.cnr-arlington-va.mbx.onr-sbir-sttr@us.navy.mil
N232-112 to N232-116	Mr. Michael Pyryt	Strategic Systems Programs (SSP)	ssp.sbir@ssp.navy.mil

PHASE I SUBMISSION INSTRUCTIONS

The following section details requirements for submitting a compliant Phase I Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposing small business concerns are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); follow proposal submission instructions in the DoD SBIR/STTR Program BAA on the DSIP at https://www.dodsbirsttr.mil/submissions. Proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that small business concerns register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified electronically in DSIP by the Corporate Official prior to BAA Close will NOT be considered submitted and will not be evaluated by DON. Please refer to the DoD SBIR/STTR Program BAA for further information.

Proposal Volumes. The following six volumes are required.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR Program BAA.

- **Technical Proposal (Volume 2)**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed 10 pages, regardless of page content
    - Single column format, single-spaced typed lines
    - Standard 8 ½” x 11” paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point
    - Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified. Phase I Options are exercised upon selection for Phase II.
    - Work proposed for the Phase I Base must be exactly six (6) months.
    - Work proposed for the Phase I Option must be exactly six (6) months.

  - Additional information:
    - It is highly recommended that proposing small business concerns use the Phase I proposal template, specific to DON topics, at https://navysbir.com/links_forms.htm to meet Phase I Technical Volume (Volume 2) requirements.
    - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.

- **Cost Volume (Volume 3).**
  - Cost Volume (Volume 3) must meet the following requirements or the proposal will be REJECTED:
    - The Phase I Base amount must not exceed $140,000.
    - Phase I Option amount must not exceed $100,000.
    - Costs for the Base and Option must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.
    - For Phase I, a minimum of two-thirds of the work is performed by the proposing small business concern. The two-thirds percentage of work requirement must be met in the Base

costs as well as in the Option costs. DON will not accept deviations from the minimum percentage of work requirements for Phase I. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor (Total Subcontractor Costs (TSC)) as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator.

- ☐ Proposing Small Business Concern Costs (included in numerator for calculation of the small business concern):
  - — Total Direct Labor (TDL)
  - — Total Direct Material Costs (TDM)
  - — Total Direct Supplies Costs (TDS)
  - — Total Direct Equipment Costs (TDE)
  - — Total Direct Travel Costs (TDT)
  - — Total Other Direct Costs (TODC)
  - — General & Administrative Cost (G&A)

  NOTE: G&A, if proposed, will only be attributed to the proposing small business concern.
- ☐ Subcontractor Costs (numerator for subcontractor calculation):
  - — Total Subcontractor Costs (TSC)
- ☐ Total Cost (i.e., Total Cost before Profit Rate is applied, denominator for either calculation)

- ○ Additional information:
  - — Provide sufficient detail for subcontractor, material, and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel.
  - — Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
  - — The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.
  All proposing small business concerns must review and submit the following items, as applicable:
  - — **Telecommunications Equipment Certification.** Required for all proposing small business concerns. The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment,

system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As such, all proposing small business concerns must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.

- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries.** Each proposing small business concern is required to complete Attachment 2 of this BAA, "Disclosures of Foreign Affiliations or Relationships to Foreign Countries" and upload the form to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
  - Program Description
  - Proposal Fundamentals
  - Phase I Proposal
  - Attachment 2
- **Certification Regarding Disclosure of Funding Sources.** Each proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. The disclosure and certification must be made by completing Attachment 4, Disclosure of Funding Sources, and uploading to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
  - Phase I Proposal
  - Attachment 4
- **Majority Ownership in Part.** Proposing small business concerns which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA. Complete certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

- Additional information:
  - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
    - Additional Cost Information to support the Cost Volume (Volume 3)
    - SBIR/STTR Funding Agreement Certification
    - Data Rights Assertion
    - Allocation of Rights between Prime and Subcontractor
    - Disclosure of Information (DFARS 252.204-7000)
    - Prior, Current, or Pending Support of Similar Proposals or Awards
    - Foreign Citizens
  - Do not include documents or information to substantiate the Technical Volume (Volume 2) (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.

— A font size smaller than 10-point is allowable for documents in Volume 5; however, proposing small business concerns are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

PHASE I EVALUATION AND SELECTION

The following section details how the DON SBIR/STTR Programs will evaluate Phase I proposals.

Proposals meeting DSIP submission requirements will be forwarded to the DON SBIR/STTR Programs. Prior to evaluation, all proposals will undergo a compliance review to verify compliance with DoD and DON SBIR/STTR proposal eligibility requirements. Proposals not meeting submission requirements will be REJECTED and not evaluated.

- **Proposal Cover Sheet (Volume 1).** The Proposal Cover Sheet (Volume 1) will undergo a compliance review to verify the proposing small business concern has met eligibility requirements and followed the instructions for the Proposal Cover Sheet as specified in the DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I proposals using the evaluation criteria specified in the Phase I Proposal Evaluation Criteria section of the DoD SBIR/STTR Program BAA, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

  The Technical Volume (Volume 2) will undergo a compliance review (prior to evaluation) to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  — Not to exceed 10 pages, regardless of page content
  — Single column format, single-spaced typed lines
  — Standard 8 ½" x 11" paper
  — Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
  — No font size smaller than 10-point, except as permitted in the instructions above.
  — Include, within the 10-page limit of Volume 2, an Option that furthers the effort in preparation for Phase II and will bridge the funding gap between the end of Phase I and the start of Phase II. Tasks for both the Phase I Base and the Phase I Option must be clearly identified.
  — Work proposed for the Phase I Base must be exactly six (6) months.
  — Work proposed for the Phase I Option must be exactly six (6) months.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will only undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  — Must not exceed values for the Base ($140,000) and Option ($100,000).

— Must meet minimum percentage of work; a minimum of two-thirds of the work is performed by the proposing small business concern. The two-thirds percentage of work requirement must be met in the Base costs as well as in the Option costs. DON will not accept deviations from the minimum percentage of work requirements for Phase I.

- **Company Commercialization Report (CCR) (Volume 4).** The CCR (Volume 4) will not be evaluated by the Navy nor will it be considered in the Navy's award decision. However, all proposing small business concerns must refer to the DoD SBIR/STTR Program BAA to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposing small business concern has included items in accordance with the PHASE I SUBMISSION INSTRUCTIONS section above.

- **Fraud, Waste, and Abuse Training Certificate (Volume 6).** Not evaluated.

ADDITIONAL SUBMISSION CONSIDERATIONS

This section details additional items for proposing small business concerns to consider during proposal preparation and submission process.

Due Diligence Program to Assess Security Risks. The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. Please review the Program Description section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns.

Discretionary Technical and Business Assistance (TABA). The SBIR and STTR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Proposing small business concerns may request, in their Phase I Cost Volume (Volume 3) and Phase II Cost Volume, to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase I TABA amount is up to $6,500 and is in addition to the award amount. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,800,000 or lower limit specified by the SYSCOM). As with Phase I, the amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project. A small business concern receiving TABA will be required to submit a report detailing the results and benefits of the service received. This TABA report will be due at the time of submission of the final report.

Request for TABA funding will be reviewed by the DON SBIR/STTR Program Office.

If the TABA request does not include the following items the TABA request will be denied.

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included in the proposal as follows:

- Phase I:
    - Online DoD Cost Volume (Volume 3) – the value of the TABA request.
    - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as "TABA" in the section titled Additional Cost Information when using the DON Supporting Documents template.
- Phase II:
    - DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
    - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as "TABA" in the section titled Additional Cost Information when using the DON Supporting Documents template.

Proposed values for TABA must NOT exceed:

- Phase I: A total of $6,500
- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

If a proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual DON STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the proposing small business concern shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DON Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DON Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the government Contracting Officer, noted in the contract.

Majority Ownership in Part. Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, **are eligible** to submit proposals in response to DON topics advertised within this BAA.

For proposing small business concerns that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

a. Prior to submitting a proposal, small business concerns must register with the SBA Company Registry Database.
b. The proposing small business concern within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents (Volume 5).
c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

System for Award Management (SAM). It is strongly encouraged that proposing small business concerns register in SAM, https://sam.gov, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a small business concern is required to implement NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items please visit https://www.sprs.csd.disa.mil/webtrain.htm.

Human Subjects, Animal Testing, and Recombinant DNA. Due to the short timeframe associated with Phase I of the SBIR/STTR process, the DON does not recommend the submission of Phase I proposals that require the use of Human Subjects, Animal Testing, or Recombinant DNA. For example, the ability to obtain Institutional Review Board (IRB) approval for proposals that involve human subjects can take 6-12 months, and that lengthy process can be at odds with the Phase I goal for time-to-award. Before the DON makes any award that involves an IRB or similar approval requirement, the proposing small business concern must demonstrate compliance with relevant regulatory approval requirements that pertain to proposals involving human, animal, or recombinant DNA protocols. It will not impact the DON's evaluation, but requiring IRB approval may delay the start time of the Phase I award and if approvals are not obtained within two months of notification of selection, the decision to award may be terminated. If the use of human, animal, and recombinant DNA is included under a Phase I or Phase II proposal, please carefully review the requirements at: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

Government Furnished Equipment (GFE). Due to the typical lengthy time for approval to obtain GFE, it is recommended that GFE is not proposed as part of the Phase I proposal. If GFE is proposed, and it is determined during the proposal evaluation process to be unavailable, proposed GFE may be considered a weakness in the technical merit of the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

Notifications. Email notifications for proposal receipt (approximately one week after the Phase I BAA Close) and selection are sent based on the information received on the proposal Cover Sheet (Volume 1). Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Debriefs. Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the proposal of the proposing small business concern within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests. Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil. A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

Awards. Due to limited funding, the DON reserves the right to limit the number of awards under any topic. Any notification received from the DON that indicates the proposal has been selected does not ultimately guarantee an award will be made. This notification indicates that the proposal has been selected in accordance with the evaluation criteria and has been sent to the Contracting Officer to conduct compliance review of Volume 3 to confirm eligibility of the proposing small business concern, and to take other relevant steps necessary prior to making an award.

Contract Types. The DON typically awards a Firm Fixed Price (FFP) contract or a small purchase agreement for Phase I. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Proposal Fundamentals, for Phase II awards the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Funding Limitations. In accordance with the SBIR and STTR Policy Directive section 4(b)(5), there is a limit of one sequential Phase II award per small business concern per topic. Additionally, to adjust for inflation DON has raised Phase I and Phase II award amounts. The maximum Phase I proposal/award amount including all options (less TABA) is $240,000. The Phase I Base amount must not exceed $140,000 and the Phase I Option amount must not exceed $100,000. The maximum Phase II proposal/award amount including all options (including TABA) is $1,800,000 (unless non-SBIR/STTR funding is being added). Individual SYSCOMs may award amounts, including Base and all Options, of less than $1,800,000 based on available funding. The structure of the Phase II proposal/award, including maximum amounts as well as breakdown between Base and Option amounts will be provided to all Phase I awardees either in their Phase I award or a minimum of 30 days prior to the due date for submission of their Initial Phase II proposal.

Contract Deliverables. Contract deliverables for Phase I are typically a kick-off brief, progress reports, and a final report. Required contract deliverables (as stated in the contract) must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

Payments. The DON makes three payments from the start of the Phase I Base period, and from the start of the Phase I Option period, if exercised. Payment amounts represent a set percentage of the Base or Option value as follows:

Days From Start of Base Award or Option	Payment Amount
15 Days	50% of Total Base or Option
90 Days	35% of Total Base or Option
180 Days	15% of Total Base or Option

Transfer Between SBIR and STTR Programs. Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa.

PHASE II GUIDELINES

Evaluation and Selection. All Phase I awardees may submit an **Initial** Phase II proposal for evaluation and selection. The evaluation criteria for Phase II is the same as Phase I. The Phase I Final Report, Initial Phase II Proposal, and Transition Outbrief (as applicable) will be used to evaluate the small business concern's potential to progress to a workable prototype in Phase II and transition technology to Phase III. Details on the due date, content, and submission requirements of the Initial Phase II Proposal will be provided by the awarding SYSCOM either in the Phase I contract or by subsequent notification.

NOTE: All SBIR/STTR Phase II awards made on topics from BAAs prior to FY13 will be conducted in accordance with the procedures specified in those BAAs (for all DON topics, this means by invitation only).

Awards. The DON typically awards a Cost Plus Fixed Fee contract for Phase II; but, may consider other types of agreement vehicles. Phase II awards can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR/STTR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 5122 of the National Defense Authorization Act of Fiscal Year 2012. The statute set-aside is 1% of the available SBIR/STTR funding to be used for administrative support to accelerate transition of SBIR/STTR-developed technologies and provide non-financial resources for the small business concerns (e.g., the DON STP).

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description. Consequently, DON will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

VERSION 7

Navy SBIR 23.2 Topic Index

VERSION 7

N232-100	Predictive Asset Rerouting and Inventory Availability for Tactical Intelligence, Surveillance, and Reconnaissance Platforms
N232-101	Expedited Commercial Imagery Delivery through Reduced Ground Processing Time
N232-102	High-Performance, No-Helium Cold Spray for Structural Repair Applications
N232-103	Machine Readable Contextual Understanding and Drilldown
N232-104	Mid-Wave Infrared Detectors with Tunable Narrow-Band Spectral Response
N232-105	Liquid Crystal on Silicon (LCoS) Micro-Displays for Deep Learning Acceleration
N232-106	Machine Learning Database to Guide Development of Low Flammability Polymer Matrix Composites
N232-107	Shipboard Carbon Capture and Storage
N232-108	Low-Cost Electronic Warfare Training Hardware
N232-109	Data Exfiltration and Communication Architecture for Cooperative, Autonomous, Underwater, Long-endurance Sensors
N232-110	Multidirectional, Multifrequency Ship-based Meteorological Satellite Receiver Using a Virtual Gimbal
N232-111	Indirect Fire Navigation without GPS or Civilian Infrastructure
N232-112	Electromagnetic Manipulation of Plasma on Hypersonic Reentry Bodies
N232-113	On-Chip Optical Isolation for Integrated Photonics
N232-114	Miniaturized, High-accuracy, Radiation-hardened Rotary Angle Sensors
N232-115	Radiation Tolerant Fiber Optic Communication
N232-116	Direct Etched Silicon Wafer Bonding for Micro-Electromechanical Systems (MEMS).

VERSION 7

N232-079 TITLE: Rapidly Deployable Assault Gap Crossing Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop gap crossing solutions that are modular, scalable, ground and air transportable, compatible with aerial delivery techniques, deployable in a short timeframe without additional construction support equipment, and capable of supporting and being transported by light- and medium-weight combat and tactical vehicles, and unmanned ground vehicles.

DESCRIPTION: The intent of this SBIR topic is to develop hasty gap crossing solutions that are transportable and deployed by tactical vehicles.
The technology must meet Threshold requirements = (T)
It is highly desirable that the technology meets Objective requirements = (O)

1. Transported by Joint Light Tactical Vehicle (JLTV) and Medium Tactical Vehicle Replacement (MTVR) (T); unmanned ground vehicle (UGV) (O).
2. Deployed by JLTV and MTVR (T); UGV (O).
3. Span a 12 meter gap (T); 15 meter gap (O)
4. Military Load Class 40 ton (T); 60 ton (O)
5. Bridge width 12 feet/3.66 meters (T=O)
6. Wheel way widths 4 feet/1.2 meters (T=O)
7. Ability to deploy the bridge, vehicles cross the gap, and then retrieve from the far bank to continue the assault (T=O)
8. Time to deploy 15 minutes (T); 5 minutes (O)
9. Time to recover 15 minutes (T); 5 minutes (O)
10. Capable of being placed in an unprepared gap (T=O)
11. Capable of being assembled with common hand tools (T); No tools (O)
12. Capable of being assembled without heavy equipment (T=O)
13. Unit cost $350,000 (T); $125,000 (O)

PHASE I: Develop concepts for rapidly deployable assault gap crossing systems that meet the requirements described above. Demonstrate the feasibility of the concepts in meeting Marine Corps requirements. Establish that the concepts can be developed into a useful product for the Marine Corps. Feasibility will be established by material testing and analytical modeling, as appropriate. Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Develop 1-2 prototype rapidly deployable assault gap crossing systems for evaluation to determine their capability in meeting the performance goals defined in the Description above. Demonstrate technology performance through prototype evaluation and modeling over the required range of parameters. Evaluation results will be used to refine the prototype into an initial design that will meet Marine Corps requirements; and for evaluation to determine its effectiveness in an operationally relevant environment approved by the Government. Prepare a Phase III development plan to transition the technology to Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Support the Marine Corps for test and validation to certify and qualify the system for Marine Corps use.

Commercial applications may include, but not be limited to: disaster relief, homeland security, emergency services, and commercial construction.

VERSION 7

REFERENCES:
1. “VIPER.”. General Dynamics European Land Systems. https://www.gdels.com/mtb.php
2. Higgins, Rae. “Joint Assault Bridge aces Operational Test; fielding plans include all COMPOs.” U.S. Army PEO Combat Support & Combat Service Support, December 11, 2020. https://www.army.mil/article/241689/joint_assault_bridge_aces_operational_test_fielding_plans_include_all_compos
3. “ATP 3-21.21 SBCT Infantry Battalion. Headquarters, Department of the Army, March 2016. https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/atp3_21x21.pdf

KEYWORDS: Bridge; bridging; gap; crossing; maneuver; mobility; transportable

VERSION 7

N232-080 TITLE: Self-driving Convoy Operation

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment;Trusted AI and Autonomy

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 the Announcement. 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 and demonstrate reliable autonomous convoy operations within narrow and confined spaces including negative obstacles such as roadside ditches.

DESCRIPTION: The Navy/Marine Corps Expeditionary Ship Interdiction System (NMESIS) provides a ground based anti-ship capability. The NMESIS utilizes an unmanned launcher based upon the Joint Light Tactical Vehicle (JLTV) chassis called the Remotely Operated Ground Unit Expeditionary Fires (ROGUE-Fires) carrier. ROGUE-Fires has several operational modes including a Leader-Follower mode which autonomously follows the path of the Leader Vehicle, which is a JLTV Heavy Gun Carrier equipped with the NMESIS Leader Kit. Leader-Follower convoy operations function well on wide roads but encounter difficulties on narrow roads, requiring switching to remote control operations. Remote control operation is designed for use at very slow speeds for parking and maintenance and are not suitable for convoy operations.

The current autonomy system relies on a combination of forward looking and backup cameras, RADAR, and LIDAR. The March Unit Leader (MUL) vehicle provides a video patch for the following ROGUE-Fires vehicles to follow. The MUL path is 18 feet wide, and the autonomy software keeps each ROGUE-Fires vehicle within the path. However, many secondary roads, dirt roads, and paths are much narrower than primary roads. This puts ROGUE-Fires vehicles in danger of leaving the road surface, possibly getting stuck in ditches, and hitting obstacles.

ROGUE-Fires utilizes sofrware derived from U.S. Army DEVCOM Ground Vehicle Systems Center (GVSC) Expeditionary Leader-Follower (ExLF). The Program Office does not have the authority to release this software.

This SBIR topic seeks to develop and demonstrate safe and reliable leader/follower convoy operations on secondary roads, trails, and paths narrower than 18 feet, ideally down to 8 feet. The command to utilize a narrower MUL path shall be user selectable by an operator in the Lead Vehicle. It is expected that operation under these conditions will be done at reduced speeds but still faster than having an operator tele-operate the ROGUE-Fires vehicles at walking speed. Demonstration utilizing RTK software is not required, but is acceptable. We anticipate having the software converted to the ROGUE-Fire Kernel in Phase II or Phase III. Adding additional sensors, such as additional cameras, LIDAR/RADAR, or SONAR is acceptable but cost and logistical burden will also be considered.

CLARIFICATIONS:

1. In the Description, there is discussion on how the ROGUE-Fires autonomy system functions. Currently for Leader/Follower, the Leader vehicle creates a MUL path map utilizing LIDAR

which is sent to the Follower vehicles. Use of the other sensors in addition to or in lieu of LIDAR is acceptable.

2. Methods for navigating in narrow and confined spaces in convoy operations do not need to rely on the current MUL Leader/Follower construct – meaning the Leader vehicle providing a map to the follower vehicle. Other methods which utilize the MUL method or operate without the Leader vehicle providing a map are acceptable.

PHASE I: Develop concepts for Autonomous Narrow and Confined Space Convoy Operations, detailing required sensors, transition between operating modes (path widths), fault tolerance, and failure modes. Concepts and Models will detail performance on various drive surfaces, weather conditions, on-road and roadside obstances including vegetation, and negative obstacles such as potholes and roadside ditches. System trade options, including sensor types, autonomous methods, and performance impacts will be completed.

Provide a Phase II development plan with performance goals and key technical milestones, and that will address technical risk reduction.

PHASE II: Based on the results of Phase I and the Phase II development plan, develop a prototype system. The prototype will be evaluated to determine its capability in meeting the performance goals defined in the Phase II development plan and the Marine Corps requirements for Autonomous Narrow and Confined Space Convoy Operations. Performance will be demonstrated through prototype evaluation and modeling or analytical methods over the required range of parameters including numerous deployment cycles. Evaluation results will be used 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.

PHASE III DUAL USE APPLICATIONS: Support the Marine Corps in transitioning the technology for Marine Corps use. Develop the Autonomous Narrow and Confined Convoy Operations system for 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.
The potential for commercial and dual-use is significant. Leader/follower convoy technology in tight quarters is directly applicable to airport cargo operations, warehousing, and future road transport, which would result in fuel and labor savings.

REFERENCES:

1. U.S. Army Combat Capabilities Development Command “Ground Vehicle Systems Center ROS-Military – ROS 2 Overview”, 30 September 2020 https://rosmilitary.org/wp-content/uploads/2020/11/CoVeR-EET-2-ROS-2-Overview-Distr-A-OPSEC-4622-1.pdf
2. U.S. Army Tank Automotive Research, Development And Engineering Center “Introduction to Robotic Technology Kernel (RTK)”, May 2018 https://www.gl-systems-technology.net/uploads/3/4/5/7/34572805/introduction_to_rtk_-_may2018_-_dista.pdf
3. ROS - Robotic Operating System (Open Source). documentation for ROS 1 and ROS 2 distributions https://ros.org/, https://docs.ros.org/

KEYWORDS: Autonomy; Self-driving; Convoy; Leader/Follower; Image Processing; Sensing

VERSION 7

N232-081 TITLE: High Expandable Sticky and Incapacitating Foam

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop a non-toxic sticky foam material capable of expanding and sticking to targets to non-lethally entangle, restrain, and disable them.

DESCRIPTION: The Marine Corps through the Joint Intermediate Force Capabilities Office (JIFCO) is seeking to develop a sticky foam material that is capable of expanding and sticking to targets in order to non-lethally entangle, restrain, and disable them.

Relevant efforts were previously developed by the U.S. Government for security purposes to support the Department of Justice, the Department of Energy, and the Department of Defense. In the 1990s, the Marine Corp developed a sticky foam gun which was used in Operation United Shield to assist in the withdrawal of UN peacekeeping forces from Somalia.

The sticky foam material developed was safe to use, but also came with few drawbacks. It introduced ancillary risks to targets such as blocking breathing airways leading to suffocation and making it impossible to transport targeted individuals due to the intense stickiness of the foam. The JIFCO is seeking to eliminate those risks as well as increase effectiveness and usability of the sticky foam material. The JIFCO supports the Joint Forces across the Competition Continuum and presents Intermediate Force Capability (IFC) relevance for contemporary operations - including irregular warfare (IW). The sticky foam disabling technology will give users the ability to non-lethally entangle, restrain, disable, and detain targets.

This SBIR effort will provide aid to the military and law enforcement to block threats for physical security applications; and tools to compete below the level of armed conflict in gray-zone missions.
In comparison with the 1990s sticky foam efforts, this SBIR topic seeks to explore innovative and new approaches to developing a highly expandable sticky foam with the following characteristics:

- Able to be contained and stored in small packages (handheld)
- Expandable: Able to expand 100s of times of its stored contents when released into the atmosphere
- Harden when fully extended in 5-10 seconds
- Immediately stick to skin and clothing upon contact
- Sticky foam disperser/launcher device (ex. Grenade, Weapon)
- Dissolvable after use with immediate removal safety kit
- Open-cell and breathable foam end state to avoid suffocation risks
- Safe non-toxic material
- Adhere to Military Standards such as MIL-STD-810, a military test standard for environmental testing

PHASE I: Explore advanced materials and concepts for the expandable sticky foam. Demonstrate the feasibility of expandable foam material and the effectiveness of its disabling properties upon activating with the atmosphere. Determine the technical feasibility of the concept design and model key elements that can be developed into a useful product for the Marine Corps and the Joint Non-lethal Weapon Program (JNWP) through analytical modeling and simulation to provide initial assessments of the concept performance.

Phase I will not require human subject or animal subject testing.
Provide a Phase II development plan with performance goals and key technical milestones that addresses technical risk reduction and defines the development of a state-of-art Expansive sticky foam.

PHASE II: Develop sticky foam material and process for prototype testing based on the result of the Phase I performance goals as defined in Phase II development plan. Demonstrate system performance through prototype evaluation and modeling to include usability and environmental performance. Use evaluation results to refine the prototype into an initial design that will meet the Marine Corps requirements. Prepare a Phase III development plan to transition the technology for the Marine Corps use.

PHASE III DUAL USE APPLICATIONS: Support the JIFCO/Marine Corps with test and validation to certify and qualify the technology to transition to the Marine Corps and the Joint Services. The advanced non-lethal technology developed under this SBIR topic would have direct application to the DoD IFC community in the joint services, civilian law enforcement, the Department of Justice, the Department of State, the Department of Energy, the Secret Service, and Customs and Border Protection.

REFERENCES:

1. Leimbach, Wendell. “The Commandant’s Guidance for the DoD Non-Lethal Weapons Program.” Marine Corps Gazette, May 2020. https://mca-marines.org/wp-content/uploads/The-Commandant%E2%80%99s-Guidance-for-the-DOD-Non-Lethal-Weapons-Program.pdf
2. Berger, David H. “Executive Agent’s Planning Guidance 2020 – Intermediate Force Capabilities – Bridging the Gap Between Presence and Lethality.” U.S. Department of Defense Non-Lethal Weapons Program, March 2020. https://mca-marines.org/wp-content/uploads/DoD-NLW-EA-Planning-Guidance-March-2020.pdf
3. “Sticky Foam.” Wikipedia. https://en.wikipedia.org/wiki/Sticky_foam

KEYWORDS: Sticky foam; non-lethal weapon, Intermediate Force Capability

N232-082 TITLE: Non-Destructive Delamination and Crack Detection Solution for USMC Hard Armor Plates

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 the Announcement. 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 low cost, portable solution to detect cracks and delamination in Enhanced Small Arms Protective Insert (ESAPI) and Lightweight Plate (LWP) hard armor plate systems.

DESCRIPTION: Currently the USMC fields two different body armor protective plate solutions. Both body armor plate systems are comprised of a polyethylene backer (made of several consolidated layers of polyethylene material) and a ceramic strikeface. The specific material makeup and the number of polyethylene layers provide the ballistic and fragmentation protective properties of the body armor plates. There are generally two primary defect modes that can take a plate out of service by significantly reducing its protection capabilities; cracking of the ceramic layer and or delamination within the polyethylene layers or between the polyethylene backer and ceramic interface. It is imperative to Marine safety to ensure the plates do not contain either defect before issuing the plate for use. Currently the USMC checks the hard armor plates on a regular basis before and after Marines use the plate in a combat or training environment. Cracking of the ceramic layer is detected using an x-ray machine while delamination is detected through a manual tap test. The tap test is performed by tapping the back face of the armor plate with a metal rod. If a plate is in good condition, the noise reflected off of the plate sounds like a chime, however a delaminated plate produces a thud sound. While the sound difference in the legacy USMC plate is audibly distinctly different between a delaminated and non-delaminated plate, the newest plate fielded by the USMC does not produce an easily identifiable sound difference between good and bad plate conditions. Another alternative to detecting both cracks and delamination is to CT scan the hard armor plates. This method is extremely expensive and requires highly trained personnel. For these reasons, the USMC seeks to fund an SBIR effort that produces a solution to regularly survey both legacy and new USMC hard armor for cracks and delamination defects. The desired prototype should represent a solution that is low cost and easy to operate such that any person without any special skills could be quickly trained. The solution should allow operators to perform plate surveillance at a throughput rate of 2-5 plates/minute. If possible, the solution should also be portable.

In summary, the crack and delamination detection system should be easy to use and understand, and accurately identify whether a hard armor plate contains a crack or delamination defect. The solution will identify the type of defect and notify operators of the plate's status (cracked vs. delaminated). The solution will also inform the operator if the plate is without defects. The solution shall not be a technology that becomes affixed to a plate.

PHASE I: Develop concepts for a non-destructive crack and delamination detection solution for USMC hard armor plates. Demonstrate and evaluate their technical feasibility. Generate a prototype to demonstrate accurate defect detection; 70-80% accurate with a plan to improve/optimize.

PHASE II: Optimize the prototype for accuracy (90% accurate with a 90% confidence level) and to include an easy-to-use user interface based on USMC feedback and data collected on hard armor plates. Demonstrate the ability to replicate the solution for a total of at least 12 detection systems.

PHASE III DUAL USE APPLICATIONS: Two systems would go to each of the six USMC gear issuing facilities across the world. Personnel at the issuing facilities who are responsible for monitoring hard armor before re-issuing the gear to Marines would use the products to test each hard armor plate for defects.

Presently, law enforcement does not monitor hard armor plates in the same way the military does. Instead, law enforcement bases the serviceability of a plate based on its recommended shelf life. If a relatively low-cost solution was created to detect cracks and delamination, law enforcement including SWAT teams (or others that employ hard armor solutions) may be interested in re-evaluating their plate surveillance methods.

REFERENCES:

1. Product Management Infantry Combat Equipment (PdM ICE). “Marine Corps Tap and Torque Tests for ESAPI plates.” Youtube, https://youtu.be/31dO_Xyj5ik
2. Testing of Body Armor Materials Phase III (2012) https://nap.nationalacademies.org/catalog/13390/testing-of-body-armor-materials-phase-iii
3. Defect Classification Tables https://navysbir.com/n23_2/N232-082-Reference_Defect.pdf
4. Table with legacy ESAPI LWP dimensions and weights - https://navysbir.com/n23_2/N232-082-Reference_Legacy_ESAPI_LWP.pdf

KEYWORDS: Armor; body amor; delamination; ceramic; cracks; non-destructive; Enhanced Small Arms Protective Insert, ESAPI; materials; Lightweight Plate; LWP

VERSION 7

N232-083 TITLE: Helicopter Seat-Integrated Power Assist Device

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

OBJECTIVE: Develop a seat-integrated power assist device that reduces low back pain and improves aircrew endurance by effectively reducing the weight of torso-mounted Personal Safety Equipment (PSE).

DESCRIPTION: The musculoskeletal burden of prolonged and repeated exposure to torso-mounted PSE has been tied to an increase in the number of complaints of fatigue and chronic low back pain among helicopter pilots. One survey of 648 Navy H-60 helicopter pilots indicated that 88.1% had experienced back and/or neck pain during or immediately after flight [Ref 1]. Fatigue and chronic back pain lead to a reduction in pilot availability, reduced operational readiness and effectiveness, shortened careers, and increased medical costs over the career and life of the aviator.

Although helicopter pilots' fatigue and low back pain are most likely attributable to several factors that include PSE weight, poor posture, seating ergonomics, vibration of the aircraft during flight, and total number of flight hours, the weight of torso-mounted PSE is considered a leading contributor to naval and military aviators' fatigue and low back pain.

This SBIR effort will be focused on the development and integration of technologies that will substantially reduce (> 70%) the effective weight of PSE. Technologies and design concepts will focus on reducing the frequency and severity of fatigue and back pain among naval aviators that must wear up to 45 lb (20.41 kg) of PSE during their flights. The main goal of the resulting technology is to protect the musculoskeletal health of naval aviators, increase their mission endurance, and to reduce the incidence of low back injuries.

Given that the H-60 type, model, series (TMS) platform is widely used across multiple services (Navy, Army, Air Force, and Special Operations Command), the program plan for this effort calls for the use of the H-60 TMS as the testbed for flight demonstration of the system. The burden of torso-mounted PPE is not unique to the H-60 platform; technology borne out of this effort is expected to be portable to other rotary-wing platforms and fixed-wing non-ejection aircraft seating systems.

It is intended that the system will:

(a) be compatible with aviator/operator body-borne mission equipment and vests,
(b) not cause a substantial increase in weight of the seating system,
(c) be retro-fittable into the H-60 pilot seat and airframe without aircraft modifications,
(d) avoid diminishment of crash performance and occupant protection of the baseline seat,

and avoid:

(a) increasing muscle activity in the torso,
(b) increasing energy expenditure (metabolic cost),
(c) reducing range of motion,
(d) impeding motion,
(e) increasing discomfort due to localized contact pressure,
(f) reducing task performance,
(g) inhibiting emergency egress, and
(h) creating abnormal spinal loading.

The goal of this effort is to develop and qualify an assistive device that reduces the load of PSE borne by military pilots. Successful completion of the work tasks outlined for each phase is designed to incrementally and iteratively build toward a qualified system.

Note: NAVAIR will provide Phase I awardees with the appropriate guidance required for human research protocols so that they have the information to use while preparing their Phase II Initial Proposal. Institutional Review Board (IRB) determination as well as processing, submission, and review of all paperwork required for human subject use can be a lengthy process. As such, no human research will be allowed until Phase II and work will not be authorized until approval has been obtained, typically as an option to be exercised during Phase II.

PHASE I: Design and develop concepts that allow for integration of the Power Assist Device (PAD) into the SH-60S seating system and component level testing to assess the feasibility and utility of the PAD system. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a prototype PAD system based on the results of Phase I and integrate into the SH-60S seat with minimal modifications to the pilot seat. Perform laboratory testing to demonstrate prototype is capable of off-loading the weight of PSE onto the pilot seat by at least 70% without increasing muscle activity in the torso, without creating or increasing any other adverse physiological condition, and without reducing the occupant’s range of motion. Develop plans and obtain approval for human-in-the-loop testing that will be conducted during the Phase II option period.

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE III DUAL USE APPLICATIONS: Further refine the PAD system design based on human testing, install on host helicopter and conduct flight testing to demonstrate PAD integrated seat can meet Navy requirements. The U.S. Government intends to conduct a wide range of testing to certify that the performance of this system warrants use onboard Navy aircraft. Broadly, the Government intends to conduct the following system levels tests in order to qualify the PAD: (a) system performance testing, (b) user acceptance testing, (c) service life characterization testing, (d) environmental exposure testing, and (e) flight demonstration testing.

As the system is designed to reduce effective torso-borne weight, services with heavy PSE will realize the greatest benefit; commercial operators with minimal body-borne equipment will have a reduced benefit from the system.

REFERENCES:

1. Phillips, A. S. (2011). The scope of back pain in Navy helicopter pilots [Master’s thesis, Naval Postgraduate School, Monterey CA]. DTIC. https://apps.dtic.mil/sti/pdfs/ADA543155.pdf
2. Bongers, P. M., Hulshof, C. T. J., Dljkstra, L., Boshuizen, H. C., Groenhout, H. J. M., & Valken, E. (1990). Back pain and exposure to whole body vibration in helicopter pilots. Ergonomics, 33(8), 1007-1026. https://doi.org/10.1080/00140139008925309
3. Cunningham, L. K., Docherty, S., & Tyler, A. W. (2010). Prevalence of low back pain (LBP) in rotary wing aviation pilots. Aviation, space, and environmental medicine, 81(8), 774-778. https://doi.org/10.3357/ASEM.2736.2010
4. Healing, R. F., & Hamon, K. (2014, May 20–22). Eliminating avoidable helicopter seating-related injuries to improve combat readiness and mission effectiveness [Paper presentation]. American Helicopter Society International 70th Annual Forum, Quebec, Canada. https://vtol.org/store/product/eliminating-avoidable-helicopter-seatingrelated-injuries-to-improve-combat-readiness-and-mission-effectiveness-9482.cfm-injuries-to-improve-combat-readiness-and-mission-effectiveness-9482.cfm

VERSION 7

KEYWORDS: Pilot Back Pain; helicopter seats, endurance; aircrew; Personal Survival Equipment; PSE; torso-mounted equipment

VERSION 7

N232-084 TITLE: Modeling and Simulation of Supersonic Turbulent Combustors for Application in Hypersonic Weapon Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics

OBJECTIVE: Develop and improve modeling and simulation tools for predicting the performance of air-breathing propulsion systems within Navy-relevant hypersonic weapons systems.

DESCRIPTION: Future naval weapon systems operating in hypersonic flight regimes (freestream Mach numbers between Mach 5 and Mach 10) likely will employ propulsion systems that utilize mixing and combustion in supersonic flows (e.g., scramjet engines).

Current design methods rely on low-order models, either empirical or from first principles, that don't account for the complex physics that occur within a hypersonic air-breathing propulsion system (i.e., inlet, isolator, combustor, and nozzle). These methods typically lack the ability to predict scramjet engine unstart, a complex physical phenomenon where the shock train is expelled from the inlet/isolator and flow through the engine becomes fully subsonic, resulting in a significant loss of thrust, vehicle performance, and maneuverability.

High-fidelity multi-physics computational fluid dynamics tools (CFD) can, in principle, better predict the complex physical mechanisms involved in scramjet unstart. However, further advancement of transient, physics-based CFD tools (e.g., reactive Large Eddy Simulation) is required to accurately predict combustion in supersonic flow within complex geometries. Improvements to multi-physics sub-grid scale models for supersonic turbulent mixing, combustion, and chemical kinetics are required. Furthermore, for realistic Navy-relevant geometries (e.g., 3D-streamline traced inlets, cavity flameholders), near-wall resolution typically suffers, and the use of wall-modeling is required. Wall-modeling improvements need to incorporate additional physics, including large thermal gradients, improved models for turbulent heat flux, near-wall boundary layer flames and near-wall combustion. Incorporation of relevant physics for advanced hydrocarbon fuels (JP-5, JP-10, and RP-2) at supercritical/transcritical regimes is also important.

Improved modeling and simulation tools are desired for predicting with confidence transient, three-dimensional, multi-phase, supersonic mixing, and combustion-within-hypersonic propulsion systems. High-performance computing and high-fidelity modeling should be leveraged to assess the mechanisms that affect scramjet engine operability and lead to unstart.

Furthermore, increased understanding of the mechanisms that lead to unstart should drive the development of reduced-order models (either from first principles or high-fidelity multi-physics models). These models are desired to quickly and accurately predict engine operability and unstart in different flight regimes to be able to impact a typical design cycle.

PHASE I: Design and develop initial improvements to high-fidelity models and surrogate/reduced order models to predict scramjet engine unstart and demonstrate feasibility. Describe the highest anticipated risks with developing the tools and potential risk mitigations. Efforts should focus on robust, parallel, highly efficient software improvements that can be utilized for complex, realistic geometries. Identify canonical scramjet design and vehicle geometry to be used in Phase II for analysis and validation. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Using the results from Phase I, develop high-fidelity, multi-physics computational fluid dynamics tool for predicting engine performance and unstart within scramjet propulsion systems. Apply the developed tool sets to a canonical, Navy-relevant hypersonic vehicle geometry in order to validate physical models and build confidence in predictive capability. Combustion methodologies should focus on Navy-specific fuels (e.g., JP-5, JP-10, and RP-2). Deliver prototype software tools on high-performance computing hardware, and document the theory, assumptions, and instructions. Demonstrate the capability to use high-fidelity models to develop surrogate/reduced-order models to quickly and accurately predict engine unstart and operability envelopes within a typical design cycle (e.g., 1–2 weeks) using modest hardware.

PHASE III DUAL USE APPLICATIONS: Transition the developed tool and capability to the Government for implementation on fleet aircraft. Modify the methodology and tools based on feedback from use within a DoD acquisition program. Support the application of advanced, mature, multi-physics design tools on inlet and engine performance in a hypersonic propulsion system.

Commercial aviation engines presently operate subsonic with standard combustors within the gas turbine engine. While vastly different aerodynamically, advanced higher fidelity methods and tools developed under this topic could be applied to other flow regimes. Chemical kinetics, combustion models, and reduced order methods could be applied to typical aircraft engine and combustor design processes.

REFERENCES:
1. Bertin, J. J., & Cummings, R. M. (2006). Critical hypersonic aerothermodynamic phenomena. Annu. Rev. Fluid Mech., 38, 129-157. https://www.annualreviews.org/doi/abs/10.1146/annurev.fluid.38.050304.092041
2. Bertin, J. J. (1994). Hypersonic aerothermodynamics. AIAA. https://books.google.com/books?hl=en&lr=&id=NKOIAY_Cj2kC&oi=fnd&pg=IA3&dq=Hypersonic+Aerothermodynamics&ots=s5gt4l_KIX&sig=PN6VYwsTlgcz6Mla3Kk3B7ysjXI#v=onepage&q=Hypersonic%20Aerothermodynamics&f=false
3. Heiser, W. H., & Pratt, D. T. (1994). Hypersonic airbreathing propulsion. AIAA. https://books.google.com/books?hl=en&lr=&id=d1sQvT2_kMsC&oi=fnd&pg=IA4&dq=Hypersonic+Airbreathing+Propulsion&ots=f8wlqo4Q6w&sig=IAlL9R6DmnJFuOiIIcfKc74S6D0#v=onepage&q=Hypersonic%20Airbreathing%20Propulsion&f=false
4. Urzay, J. (2018). Supersonic combustion in air-breathing propulsion systems for hypersonic flight. Annual Review of Fluid Mechanics, 50, 593-627. https://doi.org/10.1146/annurev-fluid-122316-045217
5. Bertin, J. J., & Cummings, R. M. (2006). Critical hypersonic aerothermodynamic phenomena. Annu. Rev. Fluid Mech., 38, 129-157. https://doi.org/10.1146/annurev.fluid.38.050304.092041
6. The HPCMP Group. (n.d.). DoD high performance computing modernization Program (DoD HPCMP). Retrieved June 30, 2022, from https://centers.hpc.mil/systems/hardware.html

KEYWORDS: Hypersonics; Computational-Fluid Dynamics; Multi-physics; Scramjet; Reduced-Order Model; Engine Unstart

N232-085 TITLE: Autonomous Precision Landing onto Non-Cooperative Targets

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems;Integrated Sensing and Cyber;Trusted AI and Autonomy

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 the Announcement. 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 modular system that enables a vertical takeoff and landing (VTOL) aircraft to precisely and repeatedly land on a small non-cooperative target, then take off again.

DESCRIPTION: Autonomous landing systems have become common in both manned and unmanned aviation. Uses span from commercial airliners to small drones. Most of these systems are GPS-based, which enables autonomous landing to an approximate location, but lacks the accuracy to enable autonomous landing in a very small or confined space, such as the deck of a boat. To enable high-precision autonomous landing, systems have been developed using additional sensors, including RTK-GPS, radar, acoustic, ultra-wideband (UWB), and vision. However, these precision landing systems require sensors and/or optical targets to be placed on the landing target prior to landing. This prevents their use with “non-cooperative targets (NCTs)”, such as the roof of a building or an enemy vessel, that are not accessible prior to the initial landing. This approach would also have applicability to EMCON conditions on current assets.

This SBIR topic seeks to develop a non-cooperative target landing system (NCTLS) to enable VTOL aircraft (manned or unmanned) to autonomously land on and take off from a small area or NCT, without a pilot providing control inputs. The NCTLS should enable the following pilot workflow:

1. The pilot designates an NCT landing site using satellite imagery or data from an aircraft-mounted sensor.
2. The NCTLS tracks the landing site in real time and generates aircraft control inputs to guide the aircraft safely onto the NCT, without any operator input.
3. The pilot may later decide to launch from the NCT; during launch, the NCTLS should track the landing site during takeoff and generate aircraft control inputs to guide the aircraft straight up relative to the NCT.

It may be assumed that the general location of the NCT is known, and that the NCT is large enough to accommodate the small unmanned aircraft system (sUAS). Landing accuracy should be less than 50% of the largest aircraft dimension (e.g., landing error for a 1000 mm diameter quadcopter drone should be less than 500 mm).

The NCTLS should be modular and adaptable to a range of VTOL aircraft. It is desirable for the NCTLS system to operate with sensor data from pre-existing sensors already on board most aircraft (e.g., GPS, IMU, imagers), however, additional sensors and computers may be added to the aircraft to enable the system. Overall size, weight, and power (SWaP) requirements of the system should be minimized. Control output signals from the NCTLS should be provided in a generalized format such as velocity or acceleration commands. The NCTLS should not interfere with other aircraft subsystems.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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 advanced phases of this contract.

PHASE I: Design and develop technology that enables autonomous landing of a VTOL aircraft on an NCT, as described above. Provide a detailed description of the system architecture and necessary input and output interfaces to integrate into a small drone. Identify key components necessary for operation. Build a prototype NCTLS and demonstrate the prototype operating in a relevant environment, landing on a stationary NCT. Identify limits of operating conditions, such as NCT environmental conditions, weather, aircraft dynamics, and sensor requirements. Develop a Phase II implementation plan. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Build, test, and validate a complete NCTLS prototype that successfully lands a VTOL aircraft on a moving NCT such as a vehicle or vessel at sea. Demonstrate the prototype system in relevant operational environments. Demonstrate portability of the system to different VTOL aircraft. Produce and deliver a final technical data package that includes system and subcomponent specifications, interface descriptions and definitions, and operating instructions for the prototype. Prepare for transition to deployment.

Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Complete final testing, and perform necessary integration and transition for use in landing/take-off operations with appropriate existing platforms and agencies, and future combat systems under development.

Commercially this product could be used to enable remote delivery/pickup of various payloads to unattended locations, surveillance/interdiction operations, and in search and rescue (SAR) operations.

REFERENCES:

1. Hintze, J. M. (2004, March 12). Autonomous landing of a rotary unmanned aerial vehicle in a non-cooperative environment using machine vision [Master’s thesis, Brigham Young University]. All Theses and Dissertations (p. 120). Brigham Young University. https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1119&context=etd
2. López-Rodríguez, P., Escot-Bocanegra, D., Fernández-Recio, R., & Bravo, I. (2015). Non-cooperative target recognition by means of singular value decomposition applied to radar high resolution range profiles. Sensors (Basel, Switzerland), 15(1), 422. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4327028/
3. Xu, G., Qi, X., Zeng, Q., Tian, Y., Guo, R., & Wang, B. (2013). Use of land’s cooperative object to estimate UAV’s pose for autonomous landing. Chinese Journal of Aeronautics, 26(6), 1498-1505. https://doi.org/10.1016/j.cja.2013.07.049
4. Zhao, Y., & Pei, H. (2012). An improved vision-based algorithm for unmanned aerial vehicles autonomous landing. Physics Procedia, 33, 935-941. https://doi.org/10.1016/j.phpro.2012.05.157

5. Department of Defense. (2006, February 28). DoD 5220.22-M National Industrial Security Program Operating Manual (Incorporating Change 2, May 18, 2016). Department of Defense. https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodm/522022m.pdf

KEYWORDS: Artificial intelligence/machine learning; AI/ML; surveillance; autonomous landing; non-cooperative; sensors; unmanned systems

N232-086 TITLE: Novel Multifunctional Materials and Lightweight Structures for Improved Small Unmanned Aerial Vehicle (UAV) Mission Capability

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials;Renewable Energy Generation and Storage

OBJECTIVE: Develop novel integrated multifunctional materials and lightweight structures to increase performance of small, unmanned aerial vehicles (UAVs).

DESCRIPTION: UAVs play an increasingly important role on the modern battlefield. Computing hardware and mass manufacturing have made camera-equipped, man-portable UAVs readily available. In order to maintain a technical advantage and increase mission capabilities, the state of the art in small UAV design and operation must be advanced by the use of novel materials and structural concepts. UAV performance could be improved by consolidating functions through the use of multifunctional materials, or novel lightweight materials. Multifunctional materials are any material or structure that integrates two or more previously separate functions. Some examples include sensors, circuitry, antennas, batteries, fluid conduits, or actuators that are embedded within, comprised of, or make up structural members [Refs 1–4]. Lightweight materials are those that advance the state of the art by making use of novel lightweight/high-strength materials and manufacturing technologies, to ensure the final part meets or improves design performance requirements and service life. Some examples include novel applications of additive manufacturing, aerogels, graphene, carbon nanotubes, or other technologies to reduce aircraft weight while maintaining structural integrity.

Proposed concepts should seek to advance the state of the art of the design and construction of Group 1–3 UAVs. New materials, technologies, or methods shall utilize novel multifunctional or lightweight/high strength materials and structural components to enable UAV designs with improvements in weight, range, and/or time on station as compared to those constructed from conventional materials.

Proposed concepts should:
Introduce new technologies, materials, or methods, which advance the state-of-the-art of UAV design through the use of multifunctional or novel lightweight materials.
Avoid areas that have already been well-explored (e.g., using topology optimization to design single-function structure) without adding significant novel value.
Be readily applicable to aircraft structural components.
For multifunctional materials, present the expected net weight savings vs using commercially-available, single-function alternatives.

For novel lightweight/high-strength materials, present comparison of the expected specific strength as compared to conventional metals/composites for aircraft structural components.
Present analysis of the ease/feasibility of manufacturing of the concept.

PHASE I: Demonstrate the proposed concept through laboratory bench testing and/or coupon testing, as appropriate. Develop material properties, based on proposed concept, for use in commercial finite element analysis tools such as ANSYS, ABAQUS, and so forth. Demonstrate the feasibility of the proposed concept by developing models to predict material behavior and model all intended functions of the concept (i.e., for multifunctional materials all intended material functions should be modelled). The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Expand on Phase I work to refine and further develop the original concept by creating and evaluating prototype parts or structures. Produce, in a production-relevant environment, a representative full-scale prototype part or structure and demonstrate its performance in a simulated or realistic environment. Identify and evaluate risks, roadblocks, and challenges of full-rate production. Specific target parts for weight reduction are to be provided as appropriate during this phase.

PHASE III DUAL USE APPLICATIONS: Validate and demonstrate an aircraft-ready part as provided in Phase II. Develop solutions to the risks, roadblocks, and challenges of full-rate production as discovered in Phase II. Commercial demand for small UAVs is increasing as the technology becomes more mature. Industries such as farming, land management, and last-mile delivery are exploring or already using systems comparable to Group 1–3 UAVs. Materials or methods developed as part of this SBIR will have direct private sector commercial potential, as they would serve to increase the overall efficiency and capability of such systems.

REFERENCES:

1. Asp, L. E., Bouton, K., Carlstedt, D., Duan, S., Harnden, R., Johannisson, W., Johansen, M., Johansson, M. K. G., Lindbergh, G., Liu, F., Peuvot, K., Schneider, L. M., Xu, J., & Zenkert, D. (2021). A structural battery and its multifunctional performance. Advanced Energy and Sustainability Research, 2(3), 2000093. https://doi.org/10.1002/aesr.202000093. https://doi.org/10.1002/aesr.202000093
2. Xu, J., Geng, Z., Johansen, M., Carlstedt, D., Duan, S., Thiringer, T., Liu, F., & Asp, L. E. (2022). A multicell structural battery composite laminate. EcoMat, e12180. https://doi.org/10.1002/eom2.12180
3. Shemelya, C. M., Zemba, M., Liang, M., Espalin, D., Kief, C., Xin, H., Wicker, E. W., & MacDonald, E. W. (2015, April). 3D printing multi-functionality: Embedded RF antennas and components. In 2015 9th European Conference on Antennas and Propagation (EuCAP) (pp. 1-5). IEEE. https://ieeexplore.ieee.org/abstract/document/7228805/metrics#metrics
4. Sairajan, K. K., Aglietti, G. S., & Mani, K. M. (2016). A review of multifunctional structure technology for aerospace applications. Acta astronautica, 120, 30-42. https://doi.org/10.1016/j.actaastro.2015.11.024

KEYWORDS: Unmanned Aerial Vehicle; UAV; Multifunctional; Material; Structure; Lightweight; Optimization

VERSION 7

N232-087 TITLE: Novel Oil Quantity Sensor for Aerospace Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces

OBJECTIVE: Design and develop an oil quantity sensor capable of measuring and assessing oil quantity, volume, and/or level of aircraft propulsion and power lubrication systems independent of oil reservoir size/form/shape of reservoir during all flight conditions. The sensor should consider aerospace requirements of low power, weight, and size and be compatible with military (MIL) and Department of Defense (DoD) Lubricant Specifications.

DESCRIPTION: The Navy requires an oil quantity sensor that greatly improves the method for identifying the oil volume within an oil tank or gearbox. Currently, oil level sensors can only accurately measure during straight and level flight and have limited sensing range, which can contribute to incorrect oil servicing and subsequent maintenance or safety events. The current sensor design is incapable of resolving oil quantities oil levels near maximum (~88%) or minimum (~23%) reservoir capacity, resulting in maintainer confusion and improper oil servicing that can lead to damaged hardware or in-flight emergencies. Current sensors are cylindrical in shape and the technology is capacitance based. The sensor developed under this SBIR topic should consider aerospace requirements of low power (less than 10 W at 5 V Alternating Current), weight of less than 2 lb (.907 kg), and size that must fit in the 23 in. x 3 in. x 3 in. (58.42 cm x 7.62 cm x 7.62 cm) envelope including power supply provisions. The sensor must operate in temperatures between -40 °F (-40 °C) and 450 °F (232.22 °C) and be compatible with MIL and DoD Lubricant Specifications. It should be capable of measuring the quantity of oil during any flight maneuver and be able to measure to the minimum and maximum capacities of the tank, regardless of tank geometry to an accuracy at least +/- 3.5 % full scale at a sample rate of at least 5 samples/sec. The sensor can mount internal or external to the tank or gearbox housing, depending on the technology. The application can vary from fixed-wing gearbox oil tanks or rotorcraft splash-lubricated gearboxes. Oil quantity will be the main function of the sensor, but added capabilities such as debris monitoring, cavitation detection, oil TAN, foreign fluids, and so forth are desirable but proposed design total weight should not exceed 2 lbs. Oil temperature monitoring may also be required to account for thermal expansion and/or oil viscosity effects. Oil temperature monitoring capabilities should roll up to the complete sensor accuracy and sample rate requirements specified herein.

CLARIFICATIONS:

- Power requirements:
  - Current: “less than 100 W at 5 V Alternating Current”
  - Recommended: “less than 10 W at 10 V Direct Current”
- Temperature requirements:
  - Current: “The sensor must operate in temperatures between -40 degF…and 450 degF…”
  - Recommended: “All sensor components exposed to oil must operate in temperatures between -40°F (-40°C) and 450°F (232.22°C) and be compatible with MIL and DoD Lubricant. If there are limitations to sensor equipment that cannot operate in this environment, an upper/lower temperature limit for this hardware should be specified.”

The original/current verbiage for power requirements was considered the best guess at the time, but we have since found updated specification requirements for this hardware and we would like to make the update to the solicitation. I don’t believe this change will fundamentally change the technical approaches of the proposals.

VERSION 7

The temperature requirements change reflects a better understanding of the operating environment for this hardware based on data received today (5/5/23) that was not available at the time of the original topic draft.

PHASE I: Design an initial concept for an oil quantity sensor architecture and develop a breadboard prototype. Demonstrate feasibility to accurately measure oil quantity and volume and describe how the technology can be applied to aerospace applications. Technology risks identified through Phase I, to include system weight, should be detailed with applicable mitigations. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Using the results from Phase I, design and build a functional prototype capable of demonstration under various simulated flight conditions, (e.g., altitude changes, representative temperature and pressure changes, etc.) with MIL and/or DoD Specification lubricants. The demonstration can use an oil tank 320–640 oz (9.46–18.93 L) in size or a splash lubricated gearbox, and should include challenging geometric features that simulate those seen with currently fielded oil tanks. The effort should focus on the accuracy, reliability, and integration of the sensor into an existing aircraft lubrication system application. Risks identified in Phase I and Phase II should continue to be tracked with mitigations identified. The size, weight, and power requirements should be detailed along with expected end item cost and any opportunities for improvements in these areas.

PHASE III DUAL USE APPLICATIONS: Install a ruggedized and calibrated prototype oil quantity sensor on a flight test aircraft and identify any hardware limitations. A cost analysis for production hardware should also be developed and presented as part of the Phase III report.
Low cost, small form-factor oil quantity measurement sensors are applicable to many commercial and military applications. This technology is applicable to oil tanks in both fixed-wing and rotorcraft applications in the commercial and military space. This development of technology under the aggressive requirements of this SBIR topic will de-risk future commercial applications that are likely to have less demanding requirements. Specific nonaviation applications may include determining quantity of hazardous and/or corrosive fluids.

REFERENCES:

1. Terzic, J., Nagarajah, R., & Alamgir, M. (2009). Accurate fluid level measurement in dynamic environment using ultrasonic sensor and v-SVM. Sensors & Transducers, 109(10), 76. https://www.sensorsportal.com/HTML/DIGEST/october_09/P_511.pdf
2. Raja, N., & Balasubramanian, K. (2020, October). Phase shift based level sensing using two guided wave mode T (0, 1) and F (1, 1) on a thin Waveguide. In 2020 IEEE SENSORS (pp. 1-4). IEEE. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9278831

KEYWORDS: Oil; Quantity; Volume; Tank; Reservoir; Fluid

VERSION 7

N232-088 TITLE: Multimode IR/RF Surrogate Seeker

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. 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: Design, develop, and demonstrate a prototype multimode seeker operating as a passive RF (Radio Frequency) and passive IR (Infrared) seeker for evaluating aircraft and countermeasure performance.

DESCRIPTION: The U.S. Navy routinely evaluates the ability of sensors to acquire and track aircraft platforms and countermeasures. IR seekers have long been the preferred method of homing in the short-range class of weapons, while RF has remained the preferred method for medium-to- long-range weapons. Dual-mode guidance, a guidance structure using both IR and RF employed across these ranges, offer improved resistance to countermeasures and counter-measuring tactics.
Passive techniques are of particular interest for homing weapons systems because of the difficulty a targeted platform has in detecting and reacting to the weapon. Traditionally missile seekers have only operated in either the RF or IR domains and on separate platforms. Each has strengths and weaknesses. While RF has superior range because IR is attenuated by the atmosphere, IR has superior angular resolution because of its shorter wavelength. This SBIR topic seeks to develop a prototype, dual-mode surrogate seeker, having both a passive RF sensor and a passive imaging IR sensor, for field test evaluation purposes. The RF sensor should operate in either the Ka or Ku band, while the IR imager should operate in the mid-wave IR (MWIR) band:

(a) Ka band: 26.5–40 GHz,
(b) Ku band: 12–18 GHz, and
(c) MWIR: 3–5 µm.

Passive RF is a class of radar that detects and tracks a target based on the target's own emissions, such as communications and Identification Friend or Foe (IFF) or reflections from non-cooperative sources such as commercial broadcast and communication signals. Both types of signals are of interest for a passive RF homing weapon. A target's own emissions are a fingerprint or unique discriminator between air platforms such as a Navy E-2 Hawkeye and a Marine MV-22 that a weapon system can identify using a database lookup table. In this way, a weapons system launched from a great distance can identify the correct target. Reflective signal in combination with emissions are important as well, providing geolocation information. Many different IR imaging algorithms exist and employ five general methods or combination of methods which are, region-based, model-based, feature-based, filtering-based, and active contour-based. The most common tracking schemes used in weapons systems combine feature and filtering methods. The feature method extracts key features from the initial frame such as an edge or a corner, while filtering establishes a target's condition from one frame to the next, such as position, speed, rotation or scale. The other methods require some a priori knowledge of the target and become more cumbersome because of the many approach angles of a targeted platform.

The two sensors provide a powerful combination that allows for target identification and geolocation, leveraging the best information each sensor.

Tracking algorithms should include schemes such as:

(a) tracking using only one sensor (either RF or IR) providing the best information,
(b) cooperative tracking, using information from both IR and the RF channels to improve target geolocation,
(c) clutter rejection: a hardened track using both IR and RF information to identify a target in a cluttered environment, and
(d) the ability to differentiate between two emitting targets.

While this topic does call for sensors operating in specific bands, the overall architecture should be open, with the end prototype having the ability to swap-in and out or add additional sensors.
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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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 advanced phases of this contract.

PHASE I: Design a concept for a dual-mode surrogate seeker having both a passive RF sensor and an imaging IR sensor and demonstrate feasibility. Design concept should include required hardware, database/look up tables and types of tracking algorithms. Identifying risk and the mitigation of those risks are key. Additionally, Phase I must include limited lab testing and demonstrations of technologies to determine the most appropriate components and methods for implementing the system. The final deliverable will be a white paper on the design of the surrogate. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Using the results from Phase I, develop and demonstrate a prototype dual mode surrogate seeker, including writing the required software algorithms to bring information of the two sensors together in a viable track. Phase II will require testing of the system during field test trials to allow the identification of shortfalls, and areas for improvement. A final demonstration of the prototype system will be done at an open test range with aircraft.
Work in Phase II may become classified. Please see note in Description paragraph.

PHASE III DUAL USE APPLICATIONS: Further refine the system design and algorithms, and incorporate additional sensors operating across the EM spectrum. Work with the Navy to transition the technology into a weapon system.

Passive RF is a developing technique for tracking aircraft without the requirement of an RF emitter. This technology is applicable in both the civilian and military aerospace industry. For the civilian, passive RF offers a relatively low-cost method of air traffic awareness, while on the military side it is of particular interest in tracking targets covertly, with the ability to identify a platform with its capabilities. With respect to developed algorithms, the fusion of sensor data and applications in machine learning have the promise of increasing accuracy in self-driving vehicles, manufacturing processes, and improve decision-making processes.

REFERENCES:

VERSION 7

1. Chandra, D. V. (1990, October). Multisensor seeker for medium-range air-to-air missiles. In Sensor fusion III (Vol. 1306, pp. 180-186). International Society for Optics and Photonics. https://doi.org/10.1117/12.34729
2. Dillon, J. E., Flanagan, J. A., Schildkraut, E. R., & Silk, J. K. (1990, September). Dual-mode (IR/RF) hardware-in-the-loop simulation facility. In Characterization, propagation, and simulation of infrared scenes (Vol. 1311, pp. 382-397). International Society for Optics and Photonics. https://doi.org/10.1117/12.21851
3. Amundson, P. H. (1996, May). One aspect of multispectral scene projection (MSSG): radar-infrared scene combination for use in hardware-in-the-loop simulation test facilities. In Technologies for Synthetic Environments: Hardware-in-the-Loop Testing (Vol. 2741, pp. 347-353). International Society for Optics and Photonics. https://doi.org/10.1117/12.241111
4. Yongchang, L. (1996). Analysis of IR/mmW Combined Seekers. National Air Intelligence Center Wright-Patterson AFB OH. https://apps.dtic.mil/sti/pdfs/ADA306509.pdf
5. Hao, K., Li, Z., Wang, X., Yang, S., Wang, Y., Xu, C., Zhou, L., & Gao, Y. (2019). Design of dual-band wide-angle RF/IR beam combiner based on impedance matching. IET Microwaves, Antennas & Propagation, 14(1), 7-14. https://ietresearch.onlinelibrary.wiley.com/doi/pdf/10.1049/iet-map.2019.0230

KEYWORDS: Radio Frequency; Infrared; Tracking Algorithm; Dual-Mode Seeker; Passive Tracking; Multi-sensor tracking

VERSION 7

N232-089 TITLE: Naval Aircrew Life Preserver Unit Automatic Inflation Device for Ejection Seat Equipped Aircraft

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

OBJECTIVE: Design and develop an innovative and affordable life preserver inflation assembly compatible with the LPU-23D/P and LPU-36A/P product lines that reduces the volume and weight, improves logistical issues of Cartridge Activated Devices (CADs), batteries, and valves, and reduces the pull force for manual inflation.

DESCRIPTION: The current Life Preserver Units (LPU) for Fixed-Wing Ejection Seat Aircraft are equipped with FLU-8B/P automatic inflation assemblies that initiate inflation automatically upon sensing water immersion. The current FLU-8B/P assembly weighs approximately 150 g without batteries or CO2 cylinder. The assembly components include a power source, CAD, water immersion sensor, compressed CO2 cylinder mount, manual inflation capability, bladder connection mount, and CO2 cylinder piercing assemblies.

The FLU-8 and its many variants are capable automatic inflator devices with a remarkable history. The original units were designed in the late 1970s and deployed in the early 1980s. Technology is now several generations ahead of the legacy FLU-8 design, making it a prime candidate for review.
A USN/USMC internal logistical constraint on the MW-14 6V alkaline batteries used to power the FLU-8B/P is that procurement control of the battery resides with Naval Sea Systems Command (NAVSEA) instead of Naval Air Systems Command (NAVAIR). Currently, the MW-14 is procured from manufacturers in a cyclic nature instead of steady state. This cyclic procurement causes a push-pull effect in the logistics chain where the end user either has too many batteries or not enough. A new commercially available power source would change logistical control and open additional procurement availability to fleet maintainers.

Proposals must describe a capability that would auto-activate LPU inflation when immersed in water. Innovative solutions should:

(a) use Berry Amendment-compliant materials and manufacturing techniques,
(b) retrofit into LPU-23D/P and LPU-36A/P product lines,
(c) reduce size and weight from current FLU-8B/P design,
(d) fully inflate within 30 s,
(e) include both automatic (primary) and manual (secondary) inflation capabilities,
(f) include an omni-directional pull for manual inflation that results in reduced pull force (objective: 15 lbf (6.8 kg) (±5 lbf [2.27 kg]),
(g) operate in brine water/freshwater/saltwater,
(h) operate in turbulent or calm water conditions,
(i) operate at a submerged depth of less than or equal to 30 ft (9.14 m),
(j) operate in cold water (32 °F [0 °C]) in brine/fresh/saltwater,
(k) operate in chlorinated swimming pool water,
(l) operate reliably in cold and hot ambient air -65–160 °F (-53.89 to 71.11 °C),
(m) operate after exposure to temperature extremes from -65–160 °F (-53.89 to 71.11 °C), mold, mildew, flame, and salt fog.
(n) Does not create hazards (injury, Foreign Object Debris (FOD), snag/trip, static discharge) in any mission or survival operations,
(o) operate after exposure to 600-knot windblast,
(p) operate after repeated exposure to altitudes of up to 70,000 ft (21.34 kg) (0.65 psi),
(q) operate after exposure to typical fixed-wing ejection seat aircraft vibration levels (frequency range of 5 Hz-2000 Hz),

(r) provide resistance to environmental contaminants (i.e., sand, petroleum, oil, lubricants, and solar radiation),
(s) not interfere with survival vest or mounted gear, armor/armor release, seat harnesses, helmets or head mounted gear,
(t) not impede water survival or land survival procedures, including raft boarding and hoisting,
(u) not contribute to wearer's burn injury hazard,
(v) not give away wearer's position in covert day or night operations,
(w) be capable of operating after 15 months in a packed state (360-day inspection cycle plus 90 day shelf life) while exposed to temperature ranges of -65 to 160°F (-53.89 to 71.11 °C),
(x) have an obvious visual indication for correct rigging, and
(y) have an obvious visual indication for Built-in Test (BIT).

The logic, data acquisition and flow, algorithm development, and the means to implement/package it with the current fixed-wing ejection seat LPU system will be key portions of the effort and will determine probability of success. It is not required, but highly recommended that performers interact with qualified naval LPU manufacturers as needed.
Note: NAVAIR will provide Phase I awardees with the appropriate guidance required for human research protocols to use while preparing their Phase II initial Proposal. Institutional Review Board (IRB) determination as well as processing, submission, and review of all paperwork required for human subject use can be a lengthy process. As such, no human research will be allowed until Phase II and human testing work will not be authorized until approval has been obtained, typically as an Option to be exercised during Phase II.

PHASE I: Develop, design, and demonstrate the feasibility of a new and innovative automatic inflation device for retrofit and operation in an LPU-23 and LPU-36 series LPU assembly. The proposed solution must demonstrate the potential for auto-activation/inflation for aircrew who have egressed a fixed-wing ejection seat aircraft into the water. Resulting concepts should include the following: dry weight, bulk/profile, required pull force for manual inflation, time for full inflation of the LPU while immersed in a swimming pool, human operated reliability, and maintainer mean time to rig, inspect, and certify "safe-for-flight". Provide experimental work that shows the technology concept will rapidly inflate the LPU in water without user input. The Phase I effort will include prototype plans to be developed under Phase II.
Note: Please refer to the statement included in the Description Section above regarding human research protocol for Phase II.

PHASE II: Develop, demonstrate, and validate an automatic inflation device prototype based on the design concept in Phase I. Device operation and capabilities demonstrations can be conducted in a laboratory environment, with the exception of water pool activation inflations. Upon prototype delivery, a Government demonstration will be performed using Navy personnel representing the 5th percentile female and 95th percentile male human subject controlled immersions, in compliance with the requirements provided in Phase I. Provide draft engineering drawings and develop life-cycle costs and supportability estimates.

Note: Please refer to the statement included in the Description Section above regarding human research protocol for Phase II.

PHASE III DUAL USE APPLICATIONS: Finalize the developed automatic inflation device technology and provide a technical data package including a performance specification, an interface control document, and engineering drawings in accordance with military standards. Develop and assist with required qualification testing and training. Finalize all testing. Document the quality assurance test program in accordance with industry best practices. Transition the technology to the fleet as a retrofit, and new procurements as required.

This SBIR topic may benefit the private sector in recreational inflatable products for which automatic inflation are desirable or required for safety Commercial Air and Sea Safety.

REFERENCES:

1. FSC 1377. (2011). Inflation device, automatic, FLU-8B/P and FLU-9B/P (MIL-DTL-32087C). Department of Defense. https://www.techstreet.com/standards/mil-mil-dtl-32087c?product_id=1959081#full
2. NAVAIR. (2020, August). NAVAIR 13-1-6.1-2 Technical manual: Aviation-crew systems: Inflatables survival equipment (Life preservers). Department of Defense. http://www.aircraft-reports.com/technical-manual-aviation-crew-systems-inflatable-survival-equipment-life-preservation-navair-13-1-6-1-2/
3. The American Society of Mechanical Engineers. (n.d.). ASME/ANSI Y14 Standards. ASME. Retrieved June 30, 2022, from https://www.asme.org/codes-standards/y14-standards

KEYWORDS: Life Preserver Unit (LPU); Auto-Inflation; Water Survival; Emergency Egress; Flotation; Aviation Life Support Systems

VERSION 7

N232-090 TITLE: Advanced, RF Transceiver Architecture

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Develop a dynamically reconfigurable, minimal latency and power VPX Digital Signal Processing (DSP) hardware base to simultaneously handle thousands of diverse, possibly overlapping signals for multi-functional situational awareness as part of a high-dynamic range digitized radio frequency (RF) transceiver for multiple Digital Signal Processing capabilities on a single processing card.

DESCRIPTION: Signal intelligence (SIGINT) is the intelligence obtained by the interception of communications and electronic signals. An Electronic Support Measure (ESM) provides the passive capability to search, intercept, collect, classify, geolocate, monitor, copy, exploit, and disseminate these signals over a specific frequency range. A key sub-system to an ESM is the RF transceiver, a single device which transmits and receives with the ability to exploit, RF signals. Current three rack unit (3U) and 6U RF transceivers are limited in the exploitation of the frequency spectrum due to constraints associated with size, weight, power, and cooling (SWaPC) of the associated electronics in the processing of the collected signals.

This topic's goal is to minimize SWaPC and design the ability to increase the signal processing resources of present 3U and 6U RF transceivers. The RF transceiver must be a single processing card while maintaining the following open interface standards:
ANSI / VITA 46.0 VPX Baseline Standard, and ANSI / VITA 48.2 Mechanical Standard for VPX REDI Conduction Cooling.

The RF transceiver must be dynamically reconfigurable via a sensor open systems architecture (SOSA) with defined application programming interfaces (API) for multiple DSP capabilities. The RF transceiver must maintain operating bandwidth throughput without interrupting receive/scan while running complex applications (e.g., emitter isolation and analysis via high-bandwidth processing for signal detection and signal classification). The RF transceiver must maintain high-bandwidth processing throughput without interrupting signal detection/classification when being loaded with complex applications (e.g., not require a reset of electronics or system). The initial design should address the RF transceiver's receiver side noise figure (NF), spurious free dynamic range (SFDR), selectivity, and input third order intercept point (IIP3). In addition, the initial design should address the RF transceiver's transmit side carrier suppression, sideband suppression, output power level, and phase noise. The RF transceiver must have minimal latency while operating over multiple channels. Hardware must be delivered with software and firmware APIs and development kits for rapid integration into U.S. Government labs.

Design tasking in Phase I and Phase II will not be classified. Analysis tasking associated with hardware 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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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 advanced phases of this contract.

PHASE I: Design and develop an initial RF transceiver solution for airborne platforms in maritime environments including an assessment of the ability of the technology solution (hardware and processing

resources) to meet SWaPC form factor as referenced in the Description above. Additional interface requirement documents (ICDs) will be supplied in Phase I. A conceptual architecture of the RF transceiver is required as a product of the Phase I effort. Phase I option should layout initial design requirements for the
(a) operating bandwidth of the RF transceiver,
(b) memory architecture and memory density,
(c) RF transceiver's receiver side NF, SFDR, selectivity, and IIP3,
(d) RF transceiver's transmit side carrier suppression, sideband suppression, output power level, and phase noise, and
(e) (Objective) verification of operational performance requirements through modelling and simulation (M&S) environment.

M & S for performance and SWaPC should be performed, the final report should include the M & S plan and the results of the M & S performed. Include prototype plans to be further developed under Phase II (e.g., associated documentation; i.e., initial block diagram, schematic, capabilities description).

PHASE II: Develop and demonstrate a prototype hardware and firmware solution, or engineering demonstration model (EDM), which builds upon the proposed solution and architecture developed in Phase I with brass-board, proof-of-concept design. A design review should be conducted early in the development phase. The effort shall include a lab demonstration, that is, the prototype hardware should be delivered at the end of Phase II, ready to be tested by the U.S. Government. The final report should include a lab demonstration plan and results, and a transition plan for Phase III focusing on an integration of the RF transceiver, including further technical maturation and manufacturability of the resulting prototype for an airborne military environment.

Work in Phase II may become classified. Please see note in the Description paragraph.

PHASE III DUAL USE APPLICATIONS: Refine the design, and lab (or ground) test, and integrate the RF transceiver solution within a government systems integration lab (SIL), and flight test. If not completed during Phase II, the Phase III design should focus on the manufacturability, production, and sustainment for compliance with the military operating environment (military standards and handbooks such as MIL-STD-810, MIL-STD-704F, MIL-STD-461, MIL-STD-464C should be used as reference until exact specifications are supplied). Phase III deliverables will include documentation not addressed during Phase II such as, but not limited to, Critical Design Review (CDR), associated Qualification Testing and analysis to support Flight Testing, performance requirements, associated ICDs, and manuals. Dual use in the commercial sector is presently limited; however, some commercial companies are addressing this with the FAA. FedEx is reviewing to install self-defense systems similar to military aircraft and helicopters, and their proposal for anti-missile infrared laser countermeasures to the FAA states "in recent years, in several incidents abroad, civilian aircraft were fired upon by man-portable air defense systems". As missile protection for commercial aircraft continues to be explored, (RF transceivers in) a modified EMS system may be used as an early warning system.

REFERENCES:

1. Karam, L.J.; AlKamal, I.; Gatherer, Alan; Frantz, G.A.; Anderson, D.V.; Evans, B.L. "Trends in multicore DSP platforms", Signal Processing Magazine, IEEE, On page(s): 38 - 49 Volume: 26, Issue: 6, November 2009. https://ieeexplore.ieee.org/document/5230802
2. B. Chapman , L. Huang , E. Biscondi , E. Stotzer , A. Shrivastava and A. Gatherer "Implementing OpenMP on a high performance embedded multicore MPSoC", Proc. IEEE Int. Parallel and Distributed Processing Symposium, 2009. https://ieeexplore.ieee.org/document/5161107
3. A.V. Oppenheim, R.W. Schafer, J.R. Buck, "Discrete-Time Signal Processing", Prentice Hall; 2 edition (January 10, 1999). https://www.amazon.com/Discrete-Time-Signal-Processing-3rd-

Prentice-Hall/dp/0131988425A.V. Oppenheim, R.W. Schafer, J.R. Buck, "Discrete-Time Signal Processing", Prentice Hall; 2 edition (January 10, 1999). https://www.amazon.com/Discrete-Time-Signal-Processing-3rd-Prentice-Hall/dp/0131988425
4. Working Group. (2019). ANSI/VITA 46.0 VPX Baseline Standard. VITA. https://www.vita.com/Standards
5. Working Group. (2020). ANSI/VITA 48.2 Mechanical Standard for VPX REDI Conduction Cooling. VITA. https://www.vita.com/Standards
6. MIL-STD-810 Working Group. (2019, January). MIL-STD 810H: Department of Defense test method standard: Environmental engineering considerations and laboratory tests. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810H_55998/
7. Naval Air Warfare Center Aircraft Division Lakehurst. (2016, December). MIL-STD-704F w/CHANGE 1: Department of Defense interface standard: Aircraft electric power characteristics. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0700-0799/MIL-STD-704F_CHG-1_55461/
8. MIL-STD-464C Joint Committee. (2010, December). MIL-STD-464C: Department of Defense interface standard: Electromagnetic environmental effects requirements for systems. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0300-0499/MIL-STD-461G_53571/
9. AFLCMC/EZSS. (2015, December). MIL-STD-461G: Department of Defense interface standard: Requirements for the control of electromagnetic interference characteristics of subsystems and equipment. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0300-0499/MIL-STD-461G_53571/

KEYWORDS: Signal Intelligence (SIGINT); (radio frequency) RF Transceiver; ESM (Electronic Support Measures); ANSI/VITA; Digital Signal Processing (DSP); High bandwidth Processing; Hybrid DSP Architectures; Signal Classification; Signal Detection; Spectral Awareness

N232-091 TITLE: Advanced Fluid Line Connectors/Fittings

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 the Announcement. 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 novel fluid line connector that reduces the likelihood of fluid leaks that can result in platform downtime and affect reliability. Technology developed under this SBIR topic will ideally be used as a new standard for fluid connections and be more reliable and maintainable than our current industry standards.

DESCRIPTION: The Navy requires a novel fluid line connection that greatly improves the reliability and ease of installation for high-pressure fluid line interfaces for aerospace applications. High-pressure fluid leaks have been found to be a major maintenance driver on several programs, negatively impacting aircraft maintenance costs, readiness, and safety. New connector technologies and designs are needed to reduce the likelihood of fluid leaks and subsequent aircraft downtime. In particular, positive indication of correct installation has been a challenge in blind installations, which has led to leaks discovered during ground turns. Both in-flight and on-ground fluid leaks can lead to negative safety events by way of loss of lube, fire, or loss of flight controls. Fluid connections are regularly touched during maintenance and require a robust design. The research and design performed under this SBIR topic will need to be unlike current fluid connection technologies used in the industry in order to show significant improvements in reliability. The technology will also need to be applicable and scalable to different applications to improve reliability throughout Navy engine platforms. Existing connections include B-nuts, Rosan fittings, and two-piece elastomer seals with backing rings, which are susceptible to poor installation or disconnection during operation. Fittings are also susceptible to high-cycle fatigue that can lead to failure, as such, the design should consider installation stresses coupled with the aerospace environment of high temperature and vibration. Connections between fluid lines, which can range in size from 0.25 in. (.63 cm) to 5 inches (centimeters) in diameter and pressure from 50–5000 psi depending on the application, should be the primary focus of this topic. Innovative solutions are being sought to fully seal pressurized aerospace fluids at a connection point without adverse effects to the fluid flow. Aircraft fluids include fuel, oil, and hydraulic fluid. The installation process and procedures should be considered throughout the design process, in addition to the manufacturing process. Integration and adaptability to current fluid tube designs will aid in future transition efforts.

PHASE I: Demonstrate, through modeling or subscale testing, the ability to fully seal pressurized aerospace fluids at a connection point without adverse effects to the fluid flow. The design can focus on fuel, oil, or hydraulics but would preferably be applicable to all three. Installation procedures should be proposed and explanation of the manufacturing process should be provided for both the seals and the fluid tube components, as well as the adaptability to current fluid tube designs. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, develop, and demonstrate functioning prototype(s) based on Phase I design concepts. Validation testing should be performed under relevant operating conditions including pressures, vibrations, humidity, and temperatures expected for the intended application. Installation should be demonstrated in various blind or hard-to-reach maintenance scenarios and appropriate mistake-proofing tests will be required. A fit check on an appropriate aircraft platform is also a possibility. Testing should demonstrate improvement over the current design for seal reliability and installation success. Consideration shall be given to aerospace quality fluid line connection standards, codes, and specifications as appropriate. Partnering with an aerospace original equipment manufacturer (OEM) is recommended—though not required—to ensure product is suitable for aircraft usage and aid in future transition opportunities.

PHASE III DUAL USE APPLICATIONS: Transition opportunities by way of partnering with an aerospace OEM or military platform is recommended to ensure a smooth and efficient transition of the technology. A partnership can allow for installation testing and fit checks on the selected aircraft platform. Engine testing can also be used to simulate the operating environment of the chosen application. An engine Acceptance Test Procedure will provide a full life cycle of the engine environment, demonstrate full life for the seal, and provide opportunities to prove out the installation process. The OEM or military platform will dictate what further testing is required for the hardware to be incorporated. Fluid connections are used throughout aerospace turbine engine, drive and mechanical systems, and aviation subsystem applications. These components in the military and commercial sector have high pressure fuel, oil, and hydraulic connections that are regularly touched for maintenance events. The technology developed under this topic is intended to be read-across to all similar high pressure fluid connections, ground ground-based applications as well, which could use improvements in reliability and ease of installation.

REFERENCES:

1. Goobich, B., Thompson, J. R., & Trainer, T. M. (1967). Development of aluminum bobbin seals for separable connectors for rocket fluid systems. Battelle Memorial Inst Columbus Oh Columbus United States. https://apps.dtic.mil/sti/pdfs/AD0817843.pdf
2. Trainer, T. M., Baum, J. V., Thompson, J. R., & Ghadiali, N. D. (1969). Development of AFRPL flanged connectors for rocket fluid systems. Battelle memorial inst Columbus OH Columbus labs. https://apps.dtic.mil/sti/pdfs/AD0857062.pdf
3. Prasthofer, W. P. (1974, January). NASA Technical Memorandum: An assessment of separable fluid connector system parameters to perform a connector system design optimization study (Report No. NASA TM X-64849). Marshall Space Flight Center, Huntsville, AL, United States. https://ntrs.nasa.gov/api/citations/19740019798/downloads/19740019798.pdf

KEYWORDS: Seal; Fluid; Connection; Connector; Leak; Fitting

VERSION 7

N232-092 TITLE: Robust Maritime Target Recognition

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

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 the Announcement. 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 robust, fully functional application from airborne electro-optics/infrared (EO/IR) imagery capable of automatically classifying combatant from non-combatant ships. The application should also be capable of target identification at a reduced range and passively compute range to target and Angle Off Bow (AOB) directly from the imagery.

DESCRIPTION: In recent years there have been a widespread embrace of a variety of deep learning techniques for automatic target recognition of ships using airborne EO/IR or radar systems. Generally, the approaches have failed to deliver robust and affordable solutions. Ship recognition requires significant examples to train the classifiers, but obtaining suitable training data is very time consuming, expensive, and impossible in many instances. These systems tend to work impressively when applied to the exact conditions to which they were trained. When faced with other conditions, even those only slightly different from those in the training data, they can react in unexpected ways. The introduction of techniques such as generative adversarial networks do begin to address this deficiency but not sufficiently in practice. A much more robust approach is a hybrid, knowledge-driven one combining an expert system utilizing template-based screeners with deep learning applied in a limited manner to elements of the classification stream where they can effectively and robustly contribute [Ref 1]. Template-based expert system classifiers have been successfully developed previously for inverse synthetic aperture radar images [Ref 2].

From a classification/identification perspective the application must provide a high probability of correct classification (> 90% threshold and > 95% objective) and identification (> 95% threshold and > 98% objective) for combatants of the world. For ships correctly classified, estimated range should be within 3% and AOB with 2°. It is estimated that the three-dimensional template database will need to represent 1,000 to 2,000 vessels. Efficient and accurate rendering of the template database is a critical element to make this approach feasible.

Investigations should consider the performance of the application as a function of pixel counts on target and image quality (i.e., target/background contrast, sensor system modulation transfer function [MTF], and noise). Overall computational resources need to be estimated for a multiple layer screening process. The merging of this expert system with deep learning techniques should be considered and pursued if justified.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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 advanced phases of this contract.

PHASE I: Research, evaluate, and develop the overall classifier architecture. Utilizing open-source data set, develop a prototype classifier to be tested on a representative set of combatant vessels. Assess the merits of a hybrid classification approach. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop an implementation of the complete classification approach including automated techniques for template preparation. Implementation should also consider system weight and power (SWAP) since the processor will be integrated into an air vehicle. Using data sets provided by the Navy, conduct a comprehensive evaluation of classification, range, and AOB estimation performance.
Work in Phase II may become classified. Please see note in the Description paragraph.

PHASE III DUAL USE APPLICATIONS: Transition the developed technology to candidate platforms/sensors. Potential transition platforms include the MQ-8C Fire Scout, MQ-4C Triton, MQ-25A Stingray, P-8A Poseidon, and Future Vertical Lift. Potential commercial applications include land-based and airborne port surveillance.

REFERENCES:
1. Marcus, G. (2020, February 17). The next decade in AI: Four steps toward robust artificial intelligence. Arxiv. https://arxiv.org/vc/arxiv/papers/2002/2002.06177v2.pdf
2. Telephonics. (n.d.). Marine classification aid (MCA). Telephonics. Retrieved March 7,2022, from https://www.telephonics.com/uploads/standard/46045-TC-Maritime-Classification-Aid-Brochure.pdf

KEYWORDS: electro-optics/infrared; automatic target recognition; vessel classification; maritime surveillance; remote sensing; template matching

VERSION 7

N232-093 TITLE: Small-Scale Air-Launched Hypersonic Weapon System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics;Trusted AI and Autonomy

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 the Announcement. 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 and demonstrate a scalable Hypersonic Surface Strike Missile airframe and propulsion system for integration onto a carrier-based strike aircraft (e.g., F/A-18, F-35).

DESCRIPTION: United States weapons development has been dependent for years on large Prime Contractors providing the majority of the design, fabrication, and testing of new systems. This approach has fielded high-quality weapons, but there are advantages in allowing smaller companies to contribute to innovations in weapons technology. Allowing for greater involvement by smaller companies will provide new innovative ideas and help speed up new technologies. This novel approach is necessary as near-peer adversaries have been investing in weapons technology at an increasing pace [Refs 2–4]. Any improvements in speeding up technology maturation and innovation would be beneficial to the United States.

Perceiving a real desire by leadership to approach future weapons development programs with a renewed effort to expeditiously develop and deliver game-changing capabilities to the warfighter at lowest cost, we must “think outside of the box”. Looking at a Non-Traditional Weapons Development strategy utilizing small business has the potential to provide much faster development to initial operational capability (IOC) and at a significant fraction of the cost as compared to the historical approach. Not only would this approach save money and time in the development cycle, it has potential to add greater agility to the needs of the warfighter than the current approach used by the Navy.

Current air-launched weapons need improvements in both range, speed, and the ability to be deployed from multiple platforms to counter threats from near-peer adversaries. Many air-launched missiles and other projectiles that meet satisfactory range needs do not have the necessary speed to fulfill current mission requirements. Often these systems use turbine propulsion technology that limits them to trans-sonic speeds [Ref 5]. Other technologies tend to be larger in size, and are therefore limited in the platforms from which they can be deployed [Ref 6]. There is a need for propulsion technologies that can be used on smaller naval air-launched platforms with strict size and weight requirements that have significant improvements in speed and range. Many current hypersonic technologies in development tend to be larger in size and are not suitable for many of the Navy’s air-launched platforms.

The weapons system being sought is expected to sustain speeds higher than Mach 4.0, and have a minimum range of 350 nautical miles (648.2 km). This system is expected to support an internal payload of 150 lb (68.04 kg) in weight, have a length less than 15 ft (4.57 m), and an overall system mass less than 2000 lb (907.18 kg). In addition, an ability to fly at a wide range of speeds is required. Multiple propulsion technologies might be employed to meet these requirements, and may include (but are not limited to) advanced turbine technologies, solid and liquid airbreathing ramjets or scramjets, rotating detonation engines, or novel hybrid technologies. For this SBIR topic, a high-speed compliment or augmentation of the Navy’s Miniature Air Launched Decoy (MALD) weapons system is desired.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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 advanced phases of this contract.

PHASE I: Design, develop, and demonstrate the feasibility of the proposed high-speed weapons system propelled by a selected propulsion technology to meet flyout requirements. A Preliminary Design Review (PDR)-level design of the vehicle and propulsion system will be expected that can meet the desired conditions, along with associated calculations, flyout predictions, and supporting analysis to assess the feasibility of the concept design. The vehicle must be designed with large-scale production and lowest life-cycle costs in mind. Subcomponent testing of key critical technologies and selected design features is encouraged during this phase. The Phase I effort will include prototype weapon system and manufacturing plans with estimated fly-away cost for five flight demonstration units to be developed under Phase III.

PHASE II: Fully develop and optimize the Phase I approach. Performance testing of the hypersonic propulsion system will be needed to validate the assumption and design proposed in Phase I. The performance testing will need to demonstrate operation in the high-speed environment for the predicted flight duration. The production/manufacturing plan will need validation through modeling and simulation. The M & S will be validated by actual component/piece part fabrication to validate the time-based prediction and Fly-Away estimated cost. Additionally, a plan and cost assessment needs to be developed to take the system into Low Rate Initial Production (LRIP).

Work in Phase II may become classified. Please see note in the Description paragraph.

PHASE III DUAL USE APPLICATIONS: Finalize development based on Phase II results for transition and integration to air-launched platforms. Conduct flight tests from Navy-provided launch platforms, demonstrating the required performance parameters in the field. Establish a pilot production capability and manufacture five airframe bodies without energetics. Provide validation on the time-based production of the propulsion system. Payload integration of government-furnished equipment (GFE) will be a consideration in Phase III.

The technologies and manufacturing approaches generated in this topic can be transferred not only into missile systems for the DoD, but into commercial/military aircraft and drones. Such technologies can be applicable to any long-range, time-critical payload delivery and/or Intelligence, Surveillance, Reconnaissance (ISR).

REFERENCES:

1. Stone, R. (2020, January 8). ‘National pride is at stake.’ Russia, China, United States race to build hypersonic weapons. Science. https://www.science.org/content/article/national-pride-stake-russia-china-united-states-race-build-hypersonic-weapons
2. AP News. (2021, October 4). Russia test-fires new hypersonic missile from submarine. https://apnews.com/article/business-europe-russia-vladimir-putin-navy-a941853d791d8b57cc1a2bc39e9d4df4

3. Reuters. (2021, October 17). China surprises U.S. with hypersonic missile test, FT reports. https://www.reuters.com/world/china-surprises-us-with-hypersonic-missile-test-ft-reports-2021-10-17/
4. Airforce Technology. (2014, June 29). Miniature air launched decoy (MALD) flight vehicle. https://www.airforce-technology.com/projects/miniature-air-launched-decoy-mald-flight-vehicle/
5. Wilson, J. R. (2019, May 1). The emerging world of hypersonic weapons technology. Military & Aerospace Electronics. https://www.militaryaerospace.com/power/article/14033431/the-emerging-world-of-hypersonic-weapons-technology
6. Department of Defense. (2006, February 28). DoD 5220.22-M National Industrial Security Program Operating Manual (Incorporating Change 2, May 18, 2016). Department of Defense. https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodm/522022m.pdf

KEYWORDS: Hypersonics; high-speed; long-range; propulsion; missile; weapon

VERSION 7

N232-094 TITLE: Blockchain-based, Highly Secure, Decentralized, and Immutable (DSI) Network System Protocol for Multifunction Advanced Data Link (MADL)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Computing and Software;FutureG;Integrated Network Systems-of-Systems

OBJECTIVE: Design and develop a secure blockchain-based system for manned aerial platform air-to-air and air-to-ground secure communication.

DESCRIPTION: The manned aerial platform can share information two ways in combat across radio datalinks and other innovations to pass targeting data, conduct surveillance, and execute attacks; however, there is the problem of detectability by the adversaries. Radio frequencies emit an electronic signature, which can emit a potentially detectable radio frequency signal. Radio interference, jamming attempts, and electronic warfare are all obstacles to maintaining secure and undetected air-to-air and air-to-ground communication.

Another important challenge is the lack of trust between communication networks that can negatively affect the activities and interaction, as well as leading to casualties, security breaches, and other irreversible consequences. To reduce the negative effects and influence of adversarial participants in the network interaction, the Navy requires the development and demonstration of a highly-secured, decentralized, permissionless, and immutable network system protocol to integrate with the manned aerial platform's Multifunction Advanced Data Link (MADL). The network privacy and security can be achieved for air-to-air and air-to-ground networks by mitigating the link attack and detecting malicious nodes, since it can achieve a consensus without introducing a third party.

The main goal of this SBIR topic is to design and develop a low-latency and high-reliability communication blockchain-based network protocol, while taking into account the specifics of the network, the high dynamics of network topology changes and the exchange of large numbers of data.

1. Analyze the indicators of reliability, sustainability, and resource provisioning of the infrastructure facilities of the systems. The solution should maintain and not degrade current standards of bandwidth for IEEE KuBand (e.g., 548 Mbps upload and 1 Gbps download speeds).
2. Design and develop a model for the interaction of the technology in the system to ensure stable and reliable delivery of information, as well as when organizing interaction between objects of mobile edge computing and the infrastructure of the operator’s network core.
3. Design and develop a complex mathematical model of the system, taking into account the interconnection of objects and channels for air-to-air and air-to-ground information transmission.
4. Evaluate performance of the developed framework for heterogeneous scenarios.

PHASE I: Design, develop, and demonstrate a zero trust, blockchain-based, decentralized, permissionless, and immutable network communications method to integrate with the manned aerial platform's MADL that can sustain the minimum data rate of 1 Gbps. Provide simulation and experimental proof-of-concept demonstration on this blockchain-based communication's security relative to that without the blockchain protocol. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop, build, demonstrate, and validate a prototype network communications method based on Phase I. Develop a network infrastructure and perform testing to explore the limits of operational reliability and latency. Experimentally demonstrate that the prototype meets or exceeds the performance specifications stated in the Description. Demonstrate the security superiority of this blockchain-based data link quantitatively relative to that of the conventional link without the blockchain protocol. Provide a production cost model.

PHASE III DUAL USE APPLICATIONS: Pursue commercialization of the technologies developed in Phase II for potential government and commercial applications. Government applications include rapid concept development and maturation for emerging military missions. There are potential commercial applications in Private sector use in telecommunication and local, urban communication that would benefit from this game-changing technology due to its blockchain-based, highly secure, decentralized, and immutable network system protocol for multifunction advanced data link.

REFERENCES:

1. Vladyko, A., Elagin, V., Spirkina, A., Muthanna, A., & Ateya, A. A. (2022). Distributed Edge Computing with Blockchain Technology to Enable Ultra-Reliable Low-Latency V2X Communications. Electronics, 11(2), 173, 2022. https://doi.org/10.3390/electronics11020173
2. Osborn, K. "The F-35 and F-22 can now speak the same language in stealth mode." The National Interest, July 8, 2021. https://nationalinterest.org/blog/buzz/f-35-and-f-22-can-now-speak-same-language-stealth-mode-189379
3. Budman, M.; Hurley, B.; Khan, A. and Gangopadhyay, N. "Deloitte's 2019 global blockchain survey." Deloitte Development LLC, 2019. https://www2.deloitte.com/content/dam/Deloitte/se/Documents/risk/DI_2019- global-blockchain-survey.pdf

KEYWORDS: Blockchain; Highly Secure; Decentralized; Immutable; Network System; Protocol; Multifunction data link

VERSION 7

N232-095 TITLE: Data Uplink Information Transfer Improvements

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems

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 the Announcement. 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 solution that enables large amounts of data to be transferred or uplinked from airborne Anti-Submarine Warfare (ASW) sensors systems, including sonobuoy sensor systems, to airborne platform receivers.

DESCRIPTION: The Navy is transitioning to digital communication links for all of its ASW sonobuoy sensors to aircraft information transfer. Digital links present limitations over traditional analog communication links, but in the end offer advantages for future Navy operations such as enabling data encryption. The Navy is seeking to overcome these limitations and increase the amount of data transferred or uplinked from airborne Anti-Submarine Warfare (ASW) sensors systems, including sonobuoy sensor systems, to aircraft receivers.

ASW is a U.S. Navy-unique mission which depends on the Electromagnetic Spectrum (EMS) to achieve its military objectives. Increased spectrum allocation for commercial enterprises has congested the EMS. Currently, transition to digital communication links for data transfer from airborne ASW sensors, including sonobuoys, is limited by the combination of limited Radio Frequency (RF) bandwidth available to use, and the need to sample and analyze large acoustic bandwidths greater than 40 kHz for transfer over the data link. It is desired that both of these areas be investigated. The current maximum data rate to the aircraft is 320 Kbps in one channel located in the 136 MHz-170 MHz VHF band. If the Navy wanted to get multiple hydrophones and/or wide acoustic bandwidth data from the buoy, then this narrow pipe is a constraint. For example, 600 kHz is the bandwidth associated with a new sensor’s RF Channel, but it can be partitioned into other RF Channels. Now the principal receiver on the aircraft is the Software Defined Radio System (SDSR).

The U.S. Navy is currently transitioning to digital transmission of data on communications uplinks. The most common limitation of digital communications is the amount of RF Bandwidth available to be used to reliably transmit the data at higher and higher data rates. Due to regulatory agencies, the Navy must consider the limitations on the amount of spectrum currently approved for use by the Navy. Using multiple channels as one channel and/or modulation scheme are valid options for this SBIR topic.
The Navy is interested in studying bandwidth-efficient modulation schemes, intended to increase the amount of information that the Navy could transmit within its constraints. As a further area of study, the Navy would like to investigate how the baseband data could be compressed, transmitted, and reproduced, as close as possible, to the original data, lossless if possible. The compression of the data should allow wider baseband data to be modulated onto the Navy’s existing links, transmitted, and decoded with little or no loss of meaningful information contained in the original waveforms. A demonstration and comparison of the tradeoff between lossy vs. non-lossy compression techniques would assist in determining the best method. In addition, the maximum increase in system noise after decompression should be no more than 1 dB relative to the pre-compressed data. Also, the transmit power should not exceed an average of 10 Watts over the sonobuoy band.

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 Counterintelligence and Security Agency (DCSA) [formerly the Defense Security Service (DSS)]. The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform work on advanced phases of this contract as set forth by DCSA and NAVAIR, and 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: Determine a viable and robust method to increase the amount of data transferred or uplinked from U.S. Navy airborne ASW sensor systems to aircraft receivers. Identify technological and reliability challenges associated with the design approach, and propose viable risk mitigation strategies. Assess the capabilities of the proposed system for future expansion. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, fabricate, and deliver a system prototype, using a SSQ101 sonobuoy, which uses the Navy's digital uplink, based on the results in Phase I. Test and fully characterize the system prototype. Work in Phase II may become classified. Please see note in the Description paragraph.

PHASE III DUAL USE APPLICATIONS: Finalize the design and fabricate a system solution that is compatible with U.S. Navy sensor systems and aircraft platforms, and assist with integration of this solution for airborne ASW purposes.
Improved data communications have application across multiple technology areas, including telecommunications worldwide.

REFERENCES:

1. O'Donohue, D. (2020, May 22). Joint publication 3-85: Joint electromagnetic spectrum operations. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_85.pdf
2. Urick, R. J. (1983). Principles of underwater sound (3rd ed.). Peninsula. https://www.amazon.com/Principles-Underwater-Sound-Robert-Urick/dp/0932146627
3. Chadwell, R. M., III. (2020, August 26). Information paper: Joint electromagnetic spectrum operations (JEMSO). USSTRATCOM J81.
4. Defense Science Board. (2015, July). Defense science board study on 21st century military operations in a complex electromagnetic environment. Department of Defense. https://dsb.cto.mil/reports/2010s/DSB_SS13--EW_Study.pdf
5. Department of Defense. (2001, July 27). Network centric warfare: Department of Defense report to Congress. http://www.dodccrp.org/files/ncw_report/report/ncw_main.pdf

KEYWORDS: Anti-Submarine Warfare; ASW; Data Communications; uplink; Radio Frequency; RF; sonobuoys; sensor systems

VERSION 7

N232-096 TITLE: Automated Fiber Optic Connector Inspection, Diagnostics, and Cleaning Tool

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop automated fiber-optic termini inspection and cleaning equipment for use on military aircraft.

DESCRIPTION: Currently automated technology exists to inspect and clean termini in military-grade connectors not installed on the aircraft. Military aircraft require that the fiber optic connectors on Weapons Replaceable Assemblies (WRAs) and disconnect panels have compact spacing that limits the usability of automated equipment. The problem is compounded by the confined working space on the aircraft.

Aerospace-grade fiber optic connectors contain multiple termini. For example, MIL-DTL-38999 connectors have up to 37 termini. Time studies have shown effective inspection and cleaning of the connector plug and receptacle with 30+ termini can take up to two hours using video inspection and manual cleaning tools currently available to the DoD. Recent aircraft modifications have seen the addition of significantly more fiber optic connector pairs containing thousands of termini. MIL-STD-1678 requires that all termini shall meet minimal optical transmissivity criteria (cleanliness) prior to final installation in the aircraft. To meet the requirement, all the termini in all the connectors must be inspected and cleaned as needed until each terminus meet the cleanliness criteria. To meet the increased demand for connector cleanliness, an innovative approach is being sought to automate the process and have the equipment fit within the perimeter of the connector and within a 6 in. clearance perpendicular to the connector. The inspection and cleaning tool can be remoted. The goal is to reduce on-aircraft maintenance time and enable inspection and cleaning within confined spaces.

The automated inspection and cleaning tool design should address the following considerations:

(a) must operate on connectors attached to WRAs, and disconnect panels meet SAE AS50881, Section 3.7.1.,
(b) have a user interface that automates termini inspection and cleaning processes,
(c) provide connectivity and data transmission, meeting Navy cyber security requirements,
(d) have only two external connections — one for 115 VAC and one for the umbilical attached to the head,
(e) operate on 115 V (50–400 Hz) or battery power,
(f) have portability per MIL-PRF-28800G,
(g) have a removable hard drive per Navy cyber security requirements,
(h) able to locate, inspect, and clean to optimize the assessment accuracy (minimum 95%),
(i) must be able to be used on connectors with no less than 37 fiber optic termini,
(j) need to adapt to MIL and ARINC shell sizes 11–25 connectors,
(k) need to adapt to ARINC rectangular connectors,
(l) capable of being qualified under MIL-PRF-28800G, and
(m) be one person carry.

PHASE I: Design and demonstrate feasibility of the inspection, diagnostics, and cleaning tool. Compare approach to existing manual and automated solutions. Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Optimize design, fabricate, and demonstrate the prototype in a simulated aircraft maintenance environment. Deliver two prototypes for Government evaluation.

PHASE III DUAL USE APPLICATIONS: The fiber optic connector, cleaning, and diagnostics technology developed under this SBIR topic could be transitioned to industry for companies that produce and sell fiber optic support equipment to both the DoD and commercial sector. The fiber optic connector, cleaning. and diagnostics technology could be used in commercial sector data centers and internet hubs.

REFERENCES:

1. Naval Sea Systems Command. (2021, November 17). MIL-PRF-28800G: Performance specification: Test equipment for use with electrical and electronic equipment. Department of Defense. https://quicksearch.dla.mil/Transient/421216E346D54B0B87A5CA9D3724A409.pdf
2. SAE Technical Standards Board. (2020, March). ARP6283/2: In-service fiber optic inspection, evaluation, and cleaning, best practices, multi-fiber push on termini. SAE. https://www.sae.org/standards/content/arp6283/2/
3. SAE Technical Standards Board. (2018, August). ARP5061/A: (R) Guidelines for testing and support of aerospace, fiber optic, inter-connect systems. SAE. https://www.sae.org/standards/content/arp5061a/
4. U.S. Department of Defense. (2019, October 7). Department of Defense Instruction: Number 8500.01 Cybersecurity. https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodi/850001_2014.pdf
5. Defense Logistics Agency Land and Maritime. (2016, October 3). Department of Defense standard practice: MIL-STD-1678-1D Fiber optic cabling systems requirements and measurements (Part 1: Design, installation and maintenance requirements) (Part 1 of 6 parts). Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-1600-1699/MIL-STD-1678_1D_55396/
6. SAE Technical Standards Board. (2019, August). AS50881G: Wiring aerospace vehicle. SAE. https://www.sae.org/standards/content/as50881g/

KEYWORDS: Fiber optics; connector; inspection; cleaning; automation; maintenance

N232-097 TITLE: Enabling Digital Metrology and Manufacturing Through the Model-Based Enterprise

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

OBJECTIVE: Design and develop innovative manufacturing and inspection processes that leverage the tenets of Digital Thread and the Model-Based Enterprise (MBE) to enable a Digital Transformation within the Department of Defense (DoD).

DESCRIPTION: Model-Based Definition (MBD) utilizes 3D datasets to contain and convey a product's definition during the manufacturing process. The larger MBE can leverage this data in downstream processes such as production, quality assurance, and logistics to consume part-specific manufacturing information in new, innovative ways. Through a previous research effort, NAVAIR developed a custom workflow for MBD parts to tie manufacture and inspection data to the part model using the Quality Information Framework (QIF) Standard. MBD has also been leveraged in industry to analyze measurement uncertainty associated with Coordinate Measurement Machines when creating part inspection plans. Through QIF, all inspection data can be associated back to the model and utilized by logistics throughout the sustainment phase of the part's lifecycle. NAVAIR identified a number of capability gaps while developing the above workflow, some unique to the defense industry. The intent of this effort is to address the capability gaps identified for the current workflow.

There are a number of factors that impact the accuracy of a measurement such as the environment in which the measurement is taken, the system taking the measurement (such as a Coordinate Measurement Machine [CMM]), and the way the dimension was defined in the Technical Data Package. The combination of these factors contribute to the uncertainty associated with each measurement. Measurement uncertainty leverages guard banding rules to restrict the tolerance range to minimize the potential to accept "bad" parts or reject otherwise "good" parts. These limits are often based on the cost implications associated with those errors. However, any deviation from the technical requirements of a Critical Safety Item (CSI) could result in loss of life or loss of aircraft. The consequence of failure for a CSI is so much greater than the cost to produce the individual part that traditional guard banding rules do not apply. The Navy has a specific need to develop a unique set of guard banding rules and measurement uncertainty principles based on part criticality as opposed to cost.

Non-contact Articulating Arms (such as a Romer Arm) have the ability to generate point cloud data quicker than contact CMMs. The point cloud data can produce valuable quality information and help augment the workload of a CMM, a bottleneck in the Organic Industrial Base (OIB). However, the OIB does not currently leverage articulating arms as inspection tools, because the measurement uncertainty is not well quantified. This effort aims to quantify the measurement uncertainty of non-contact articulating arms for inspection purposes.

The Navy has the means to calculate measurement uncertainty for CMM inspection plans. Current techniques leverage an initial condition for the inspection plan, which requires input from the CMM operator. The CMM operator currently needs to manually add/remove inspection points to find an optimized inspection plan that meets the measurement uncertainty requirements. The downside to this approach is that it is unclear whether a local or global optimization has been achieved with respect to the time and cost required to perform the inspection. The Navy is seeking a tool that can automatically optimize the inspection plan for time and cost while maintaining the required measurement uncertainty. The goal of this effort is to modify the previously developed workflow, based on the outcome of the above objectives. Currently, there is an abundance of applications and file exchanges/handoffs. This effort will integrate the various operations into one Digital Enterprise Tool, such as DEXcenter, where various workflows could be exercised to support functionality at the enterprise-level. This effort will focus on integrating this new workflow into a Digital Enterprise Tool that the OIB can leverage.

PHASE I: Phase I will focus on addressing the previously identified capability gaps in the current workflow. This includes, but is not limited to, the development of new guard banding rules based on part criticality, measurement uncertainty principles for articulating arms, and a tool to optimize inspection plans for time and cost based on the measurement uncertainty requirements. Demonstrate the feasibility of a tool or set of tools that can address the above capability gaps in a lab environment. A lab environment may leverage a test artifact with controlled model based technical requirements captured in the QIF format to evaluate the tool's performance. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Develop a new process workflow for the OIB that leverages the solutions developed in Phase I. This workflow shall integrate with existing manufacturing practices to reduce any burden associated with deployment of MBE to the OIB. It will also consist of the re-packaging and deployment of the new workflow to run directly on Navy databases. Phase II of this effort will integrate the various operations into one Digital Enterprise Tool. Once deployed, demonstration and validation will be performed using actual Navy data in prototype manufacturing environment.

PHASE III DUAL USE APPLICATIONS: To demonstrate the developed capability, the tool will be leveraged on production parts to fully characterize the measurement uncertainty of that inspection plan. The new capability should minimize any unique modifications of the part to complete the analysis in a production environment. Once complete, the tool will be transitioned for ownership by NAVAIR under the guidance of PEO-CS Digital Thread Team and/or NAWCAD LKE's Digital Enterprise Tools Branch. There are many industries outside of the Navy including, but not limited to, the medical field and the aerospace industry that produce critical parts where the consequence of failure cannot be easily quantified by cost. Those industries would benefit from criticality-based guard banding rules.
Manufacturers that produce a high quantity of a particular component will benefit from even a small reduction in the time it takes to perform an inspection. Specialized, expensive manufacturing techniques like a CMM can negatively impact the inspection process. Nonorganic manufacturing facilities would also benefit from quicker, cheaper, optimized inspection plans.

REFERENCES:

1. Taylor, B. N., & Kuyatt, C. E. (1994). NIST Technical Note 1297: Guidelines for evaluating and expressing the uncertainty of NIST measurement results. NIST. https://www.nist.gov/pml/nist-technical-note-1297
2. Working Group 1. (2008). JCGM 100: 2008: Evaluation of measurement data – Guide to the expression of uncertainty in measurement. Joint Committee for Guides in Metrology. https://www.bipm.org/documents/20126/2071204/JCGM_100_2008_E.pdf/cb0ef43f-baa5-11cf-3f85-4dcd86f77bd6

KEYWORDS: Model-Based Definition; Digital Thread; Measurement Uncertainty; Guard Banding; Manufacturing; Coordinate Measurement Machines

VERSION 7

N232-098 TITLE: Photodetector and Optical Subassembly for Digital Fiber Optic Receiver

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop and package uncooled photodetectors and optical subassemblies for military digital optical communications applications that can operate in air platforms at 10, 25, 40, 50, and 100 Gbps using binary, non-return-to-zero, on-off keyed data modulation techniques in fiber optic receivers.

DESCRIPTION: Current airborne military (mil-aero) core avionics, electro-optic (EO), communications, and electronic warfare systems require ever-increasing bandwidths while simultaneously demanding reductions in space, weight, and power (SWaP). The effectiveness of these systems hinges on optical communication components that realize high per-lane throughput, low latency, large link budget, and are compatible with the harsh avionic environment.

As digital avionics fiber-optic transmitter transmission rates increase from 10–100 Gbps, a new fiber-optic receiver will be required. A key enabling component in the fiber-optic receiver is a high-sensitivity and saturation photodetector that is compatible with 50 µm core multimode optical fiber, and various connectorized and fiber-pigtailed subassembly designs for both single-wavelength multimode fiber receivers and wavelength de-multiplexed and receiver arrays. The photodetectors should enable 15 dB receiver loss budget performance at 10 Gbps, 25 Gbps, 50 Gbps, and 100 Gbps. Photodetectors should be compatible with shortwave wavelength division multiplexing (SWDM) (844–1000 nm) and coarse wavelength division multiplexing (CWDM) (1271–1331) wavelength band ranges. Individual photodetector designs are acceptable for each wavelength band. The photodetector optical subassemblies should be compatible with 4 X 10 Gbps, 2 X 20 Gbps, 4 X 25 Gbps, 1 X 50 Gbps, 2 X 50 Gbps, and 1 X 100 Gbps transmission speeds. The optical subassemblies should be compatible with 50 µm core OM4 multimode optical fiber inputs, and 10 Gbps, 25 Gbps, 40 Gbps, 50 Gbps, and 100 Gbps receiver electronic circuits. The optical subassemblies are expected to operate over a -40° to +95° Centigrade temperature range.

PHASE I: Develop a design concept for photodetectors and their optical subassemblies for military digital fiber-optic communication applications. Demonstrate the feasibility of the photodetector design, showing a path toward meeting Phase II goals. Show optical subassembly design compatibility with fiber-optic inputs and receiver circuits. Demonstrate the feasibility of the concept to meet the described parameters listed in the Description through modeling, simulation, and analysis. The Phase I Option, if exercised, will include initial design specifications and capabilities description to build prototype solutions in Phase II. Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design and develop prototype photodetectors optimized using results from Phase I. Build and test the photodetectors and photodetector optical subassemblies and deliver to the Navy. If necessary, perform root-cause analysis and remediate photodetector and optical subassembly failures.

PHASE III DUAL USE APPLICATIONS: Transfer the photodetector and optical subassembly design to a high-speed digital fiber optic receiver supplier. Photodetector and optical subassembly technology could be used in commercial data center and/or internet provider installations.

REFERENCES:

1. Binh, L N. (2017). Advanced digital optical communications (2nd ed.). CRC Press. https://www.routledge.com/Advanced-Digital-Optical-Communications/Binh/p/book/9781138749542

2. Verbist, J., Verplaetse, M., Srivinasan, S. A., De Heyn, P., De Keulenaer, T., Pierco, R., Vaernewyck, R., Absil, P., Torfs, G., Yin, X., Roelkens, G., Van Campenhout, J., & Bauwelinck, J. (2017, March). First real-time 100-Gb/s NRZ-OOK transmission over 2 km with a silicon photonic electro-absorption modulator. In Optical Fiber Communication Conference (pp. Th5C-4). Optical Society of America. https://opg.optica.org/abstract.cfm?URI=OFC-2017-Th5C.4
3. Ozkaya, I., Cevrero, A., Francese, P. A., Menolfi, C., Morf, T., Brändli, M., Kuchta, D. M., Kull, L., Baks, C. W., Proesel, J. E., Kossel, M., Luu, D., Lee, B. G., Doany, F. E., Meghelli, M., Leblebici, Y., & Toifl, T. (2018). A 60-Gb/s 1.9-pJ/bit NRZ optical receiver with low-latency digital CDR in 14-nm CMOS FinFET. IEEE Journal of Solid-State Circuits, 53(4), 1227-1237. https://doi.org/10.1109/JSSC.2017.2778286
4. AS-3 Fiber Optics and Applied Photonics Committee. (2018, January). AS5750A Loss budget specification for fiber optic links. SAE. https://saemobilus.sae.org/content/as5750a
5. The MIL-STD-810 Working Group. (2008, October). MIL-STD-810G: Department of Defense test method standard: Environmental engineering considerations and laboratory tests. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/
6. AS-3 Fiber Optics and Applied Photonics Committee. (2018, August). Aerospace Standard ARP6318: Verification of discrete and packaged photonic device technology readiness. SAE International. https://saemobilus.sae.org/content/arp6318
7. Wang, B., Huang, Z., Sorin, W. V., Zeng, X., Liang, D., Fiorentino, M., & Beausoleil, R. G. (2019). A low-voltage Si-Ge avalanche photodiode for high-speed and energy efficient silicon photonic links. Journal of Lightwave Technology, 38(12), 3156-3163. https://doi.org/10.1109/JLT.2019.2963292
8. Defense Logistics Agency Land and Maritime. (2016). MIL-STD-883K: Department of Defense test method standard: Microcircuits. Department of Defense. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-883K_54326/

KEYWORDS: Photodetector; fiber optics; communications, digital; receiver; optical subassembly

VERSION 7

N232-099 TITLE: Utilizing Mesh-Networking for Greater Maritime Situational Awareness from Vertical Lift Aircraft

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems

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 the Announcement. 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 an innovative solution utilizing low, medium, and high bandwidth mesh networking radios that could be deployed from a vertical take-off and landing (VTOL) aircraft during an anti-submarine warfare (ASW) mission to improve maritime situational awareness.

DESCRIPTION: Modern technology allows for innovative new-use cases for low-cost mesh-networking radios to perform tasks for maritime situational awareness during missions such as ASW/anti-Surface Warfare (ASuW) amongst other critical key naval activities. With availability of components to construct new innovations in communications technology that can be deployed from Vertical Lift aircraft by means such as AN/ALE-47 flare dispensers, canister configurations, or door thrown deployment methods to provide floating mesh-networking nodes; greater maritime situational awareness methods are now possible at a lower cost. In an ASW exemplary use case, types of sonobuoys can include, but are not limited to, active and passive sonar capabilities to allow a wide swath of maritime area to be monitored and a greater magazine depth of sensors per Vertical Lift platform without the use of any tethered system traditionally used. In addition, the ability for floating mesh-networking nodes, allow greater Joint All-Domain Command and Control (JADC2) across the Joint Force and coalition partners.

This SBIR topic addresses the need to design and test basic mesh-networked nodes on the ocean surface in meaningful naval use-cases. Such radios can include, but are not limited to, existing COTS/MIL mesh-networking radios that exist such as:

(a) High Frequency radios can be considered, but power and antennae analysis must be included in the design (atmospheric bounce – low bandwidth),
(b) Somewear Labs (satellite mesh-networking – low bandwidth),
(c) goTenna/Beartooth (UHF/VHF mesh-networking – low bandwidth),
(d) Doodle Labs/Trellisware/Persistent Systems/Silvus (UHF mesh networking – medium to high bandwidth), and
(e) Banshee (5G mesh networking – medium to high bandwidth).

Following deployment of maritime surface relevant payloads, the communications systems need to demonstrate their ability to mesh-network based on terrestrial limits, mesh-network via satellite/airborne node (e.g., UAV/high-altitude balloon/manned aircraft), and its ability to provide data reach back over multiple ‘hops’ to allow standoff detection capability from a distance for naval forces. The floating communications system should operate for a useful time measure in the maritime environment (e.g., 24 hrs [threshold]/7 days [objective]).

Design solutions should consider the following three areas: 1) sonobuoy payload performance objectives, 2) communications/mesh-networking performance, and 3) overall conceptual system survivability in a maritime environment. These areas are described in more detail below:
Area #1 Sonobuoy Payload Performance Objectives:

(a) Size, Weight, Power, Cost projections (SWaP-C) of the floating communications mesh networked proposed system; to include various sizes as noted previously, ALE, Canister, and hand-thrown systems, proposed CONOPs or uses-cases and description of employment and health of overall mesh-network to assist in achieving relevant maritime domain objectives, and
(b) reliably deployed in sea-state conditions 0 through 5 (international scale), with estimations of their communications ability in calm to severe weather.

Area #2 Communication/s mesh-networking performance:
(a) predicted terrestrial mesh-networking ranges and bandwidth at-sea,
(b) predicted terrestrial mesh-networking ranges and bandwidth at-sea with UAV/high-altitude balloon/satellites,
(c) range and data budgets provided at range and over multi-hop mesh-networking scenarios; graceful degradation of 'useful' notional payload information,
(d) address potential Primary/Alternate/Contingency/Emergency (PACE) combined mesh-networking options, and
(e) unique undersea communications relays will be considered, but are not primary to this topic (e.g., floating payload to unmanned underwater vehicle (UUV) to floating payload communications—acoustic).

Area #3 Overall conceptual system survivability in a maritime environment:
(a) utilizing Area #1 and Area #2 describe the overall system performance characteristics conceptually (i.e., duration of sensor, communications capabilities in various maritime environments, storage and shelf-life of sensor/mesh-network radio),
(b) complete conceptual design and employment of sensor uses for VTOL aircraft, and
(c) initial costs for low rate initial production (LRIP) and full-rate production costs.

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 Counterintelligence and Security Agency (DCSA) formerly Defense Security Service (DSS). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and NAVAIR 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 advanced phases of this contract.

PHASE I: Develop, initial design, and demonstrate the feasibility of a mesh-networked floating communications payload and design. Identify the three areas conceptually to understand the technological and reliability challenges of the design and approach, and risk mitigation steps. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, fabricate, and deliver units (minimum of three) of mesh-networked floating payloads/communications systems based on the design from Phase I. Test and fully characterize the system prototype in a controlled environment to determine limitations of the system, in anticipation of greater testing in Phase III with naval forces in a relevant DoD sponsored exercise.
Work in Phase II may become classified. Please see note in the Description paragraph.

PHASE III DUAL USE APPLICATIONS: Product should be interoperable with United States Navy (USN)/United States Marine Corps (USMC) and Joint Force C4I systems and will be utilized in a greater DoD sponsored exercise held by the USN or USMC to demonstrate the capability to the naval forces. Testing will be overseen by the USN and USMC to assess the new capability in an operationally relevant test area (likely CONUS waters).) The ability to demonstrate reachback capability for USN/USMC assets

will be critical to show success of the network. Upon successful testing and demonstration in a relevant exercise, in full or in part, the prototypes should be delivered to the sponsoring agency or Program Management Activity that decides to take the final technology package forward.
Commercial and dual-use applications can include, but not limited to, emergency communications for ships in transit or in distress, monitoring of marine mammal life, and creating bandwidth in large maritime areas for communications where satellite coverage could be lacking. Such technology developed under this SBIR topic could greatly assist with not only a DoD mission of maritime awareness, but civilian and environmental research as well.

REFERENCES:

1. Cilfone, A., Davoli, L., Belli, L., & Ferrari, G. (2019). Wireless mesh networking: An IoT-oriented perspective survey on relevant technologies. Future Internet 2019,11(4), 99. https://www.mdpi.com/1999-5903/11/4/99/htm
2. Pike, J. (2000). AN/ALE-47 countermeasures dispense system (CMDS). FAS Military Analysis Network. https://man.fas.org/dod-101/sys/ac/equip/an-ale-47.htm
3. L3Harris Technologies, Inc. (n.d.). Sonobuoy launching system. Retrieved March 15, 2022, from https://www.l3harris.com/all-capabilities/sonobuoy-launching-system
4. Holler, R. A. (2014). The evolution of the sonobuoy from World War II to the cold war. NAVMAR Applied Sciences Corp Warminster PA. https://www.navairdevcen.org/PDF/THE%20EVOLUTION%20OF%20THE%20SONOBUOY.pdf
5. Commotion Wireless. (n.d.). Guidelines for mesh networks. Retrieved March 15, 2022, from https://commotionwireless.net/docs/cck/networking/guidelines-for-mesh/
6. Cisco Systems, Inc. (2015). Cisco wireless mesh access points, design and deployment guide, release 8.0. https://www.cisco.com/c/en/us/td/docs/wireless/technology/mesh/8-0/design/guide/mesh80/mesh80_chapter_0100.html

KEYWORDS: MANET; mesh-networking; payloads; sensors; communications; JADC2; maritime domain awareness

N232-100 TITLE: Predictive Asset Rerouting and Inventory Availability for Tactical Intelligence, Surveillance, and Reconnaissance Platforms

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Trusted AI and Autonomy

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 the Announcement. 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 software tool capability to incorporate automated rerouting of available taskable and fixed trajectory Intelligence, Surveillance, and Reconnaissance (ISR) platform asset inventory within a designated range of Areas of Interest (AOIs).

DESCRIPTION: The Navy relies on a mixture of space-based and tactical air/surface ISR platforms to maintain enhanced battlespace awareness in contested operating areas. Commercial and DoD space sensors (i.e., “fixed trajectory” platforms due to constraints of orbital mechanics) contribute a significant portion of the Navy’s battlespace awareness information; however, there remain substantive gaps in sensor coverage. Commanders can address coverage gaps with manned and unmanned tactical platforms which are able to be tasked to specific operating regions (i.e., “taskable” sensors).

With the advent of diverse collection platforms, the Navy is interested in developing a tool and capability to fully leverage these platforms. Existing tools provide orbitology predictions using timely data such as Earth Orientation Parameters (EOP), Leap Seconds, and up-to-date Satellite Databases. A capability is needed to coordinate between taskable and fixed trajectory platforms that optimizes taskable ISR platform inventory management to reduce coverage gaps in collection of data and provide sufficient collection of tactical data in a timely manner to meet the Commander’s intent of responsiveness during dynamic over-the-horizon (OTH) requirements. Currently there is no commercial capability that exists that can accomplish this task.

Once a fixed trajectory platform achieves a downlink for an AOI, the revisit rate could take 5-10 days for the asset to return to the same location. Other options include waiting for the next available asset. Low earth orbit (LEO) satellites take between 90 minutes to 2 hours to complete one orbit and are only communicating with a ground station for 5-10 minutes at a time. This time-consuming delay in data transfer can delay critical decisions and resource allocation. In-theater needs data transmitted quickly and reliably. By rerouting near-by taskable and tactical ISR platforms, observation gaps for the AOI will be significantly reduced or optimized. Leveraging nearby taskable and fixed trajectory platforms would improve responsiveness and effectiveness for maritime applications by maximizing the custody over the AOI. Enabling asset rerouting capabilities as well as inventory management, tactical ISR platforms can support Naval missions more effectively. The warfighter will receive data faster allowing for course of actions to be developed sooner rather than waiting for the next planned in-orbit asset or the revisit rate of the engaged asset.

The entire Tasking, Collection, Processing, Exploitation, and Dissemination (TCPED) process should be automated using Artificial intelligence (AI) and machine learning (ML) algorithms to improve the response times to request rerouting opportunities. The automation needs to be an open Application Programming Interface (API) design capable of establishing a bi-directional machine to machine (M2M) interface with diverse Command and Control (C2) software systems. In addition, the tool needs to be capable of uploading tactical system mission plans (e.g., flight plans for a manned aircraft mission), capable of assessing collection coverage gaps and opportunities to increase persistence with available taskable sensor inventory, and capable of providing sensor tasking recommendations to C2 systems. This request process could be as simple as using a smartphone to request a ride sharing service.

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 Counterintelligence and Security Agency (DCSA). The selected contractor 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 DCSA and NAVSEA 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 a concept for a software tool that automates rerouting of available ISR platform asset inventory within a designated range of AOIs. Demonstrate the concept meets parameters in the Description. Feasibility must be demonstrated through modeling and analysis and should include an example of how suggestive tasking or alerts of taskable assets can be modified when considered against fixed trajectory assets, with considerations for how best to depict it to the user. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype software tool from concept development in Phase I. Demonstrate that the prototype meets parameters of the Description. The prototype will be tested to demonstrate coordination between various tactical ISR platforms to de-conflict flight paths while rerouting the most feasible option in a designated range of the AOIs.

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 Navy in transitioning the technology for use in wartime environment. Develop software for MTC-A/X that integrates tactical ISR mission planning with fixed trajectory collection feasibility so the Navy and Marine Corps can evaluate the tool’s effectiveness in optimizing availability of these platforms in operationally relevant scenarios. Support MTC-A/X for testing and validation to certify and qualify the capability for Navy use.
Ground based maps use rerouting opportunities via applications such as Google Maps or Waze. FAA uses Air Traffic Control Systems to reroute flights as needed to prevent collision. Leveraging these technologies to enable the ability to reroute taskable and ISR platforms will increase opportunities to view AOI in a timely fashion. Areas suffering from natural disasters would have more opportunities to observe changes to develop a course of action to prevent further disasters.

REFERENCES:

1. Reporter, DA, "Using Unmanned Platforms for Tactical ISR," 12-January 2022, Defense Advancement, https://www.defenseadvancement.com/news/using-unmanned-platforms-for-tactical-isr/
2. Lockheed Martin, “New Tactical ISR Satellites Provide Global, Persistent Support For Warfighters,” 13-April 2021, LMNews, https://news.lockheedmartin.com/tactical-isr-satellites
3. Cole, Sally, “Unmanned Aircraft Systems Enable Tactical ISR,” 27-April 2015, Military Embedded Systems, https://militaryembedded.com/unmanned/isr/unmanned-enable-tactical-isr

VERSION 7

KEYWORDS: Intelligence, Surveillance, and Reconnaissance; taskable trajectory platforms; Inventory Management; Fixed Trajectory; Artificial Intelligence; Machine Learning.

N232-101 TITLE: Expedited Commercial Imagery Delivery through Reduced Ground Processing Time

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Trusted AI and Autonomy

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 the Announcement. 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 capability for edge node image processing latency reduction in the overall tasking to exploitation timeline.

DESCRIPTION: Units and organizations located in austere and/or denied locations require timely receipt of imagery to conduct operations. Recent advances in the ability to directly downlink raw imagery from commercial high resolution imaging satellites to Navy edge nodes located in the field promises to dramatically cut the time between when the image is taken and when it is available for exploitation. Units and organizations with little data connectivity can receive timely imagery and exploit it locally; however, even after the reductions provided by direct imagery delivery, processing time at the local edge nodes remains a bottleneck in this process. Current commercial edge node imagery processing often takes longer than 15-20 minutes to complete. The Navy seeks a solution that will shorten the processing time for imagery from tasking to imagery exploitation. There is currently nothing on the commercial market that can solve this issue.

The Navy needs a software solution that can reduce edge node processing times to below 5 minutes with a goal of sub minute processing times. The solution must run on local hardware at the edge node location, except in the case that processing occurs on-orbit before direct downlink (DDL). Software is expected to run on commodity hardware consisting of either CPU’s and/or GPU’s. A limited amount (1-2 rack units) of additional hardware, such as FPGA’s, may also be proposed in conjunction with the software. If additional hardware is added it must be rack mountable. Any modifications to the final processed image must not impact or reduce its exploitation potential.

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 Counterintelligence and Security Agency (DCSA). The selected contractor 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 DCSA and NAVSEA 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 a concept for edge node image processing time reduction tool in the overall tasking to exploitation timeline that meets the parameters in the Description. Feasibility must be demonstrated through modeling and analysis. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Develop and deliver a prototype edge node image processing time reduction tool from concept development in Phase I. Demonstrate that the prototype meets parameters of the Description. The prototype will be tested to determine the capability meets performance goals of Navy requirements.
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 Navy in transitioning the technology for Navy use. Refine the prototype for use in Navy edge nodes. Support the Navy for testing and validation to certify and qualify the capability for Navy use.

Faster processing of images directly delivered to customers would be very helpful to first responders in disaster areas. The techniques used could also be applied to commercial applications to overall reduce processing time such as accidents, natural disasters, flooding and other rapidly changing situations with first responders.

REFERENCES:

1. Ochs, Adam J., "Use of Commercial Imagery Capabilities in Support of Maritime Domain Awareness," June 2015 Naval Postgraduate School Thesis. https://apps.dtic.mil/sti/pdfs/ADA632504.pdf.
2. Hitchens, Theresa, "Army NRO Pioneer Direct Sat Imagery Downlink in Scarlet Dragon," 11-October 2011, Breaking Defense. https://breakingdefense.com/2021/10/army-nro-pioneer-direct-sat-imagery-downlink-in-scarlet-dragon/

KEYWORDS: Imagery Processing; Edge Node; Latency; Ground Processing; Imagery Exploitation; direct imagery delivery

VERSION 7

N232-102 TITLE: High-Performance, No-Helium Cold Spray for Structural Repair Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop a high-performance cold spray system which can deposit structural quality repair material for aluminum and titanium without using helium as the carrier gas.

DESCRIPTION: High-performance cold spray systems require helium carrier gas to achieve required particle deposition velocity and high-performance deposits of aluminum, titanium, and high-strength steel that have lower than 1% porosity [Ref 1]. Helium is a limited resource, expensive and highly sensitive to changes in market supplies, some of which come from Russia and other foreign countries. The cost of helium is currently about 100 times more than nitrogen, which is used in cold spray systems, but produces material with up to 10% porosity [Ref 2]. As such, the cost of helium for most repairs under consideration is a large percentage of the overall repair cost and reduces the cost-benefit for many applications. In addition, access to helium can be restricted, impacting testing and repair schedules.

A cold spray system that does not use helium and can deposit aluminum, titanium, and high-strength steel with the properties of these materials deposited using today's high-pressure, helium-based systems is needed.

PHASE I: Develop a concept for a cold spray system that can deposit aluminum, titanium, and high-strength steel at lower than 1% porosity without using helium. Demonstrate feasibility of meeting pressure, operating temperature, transfer efficiency, interfacial adhesion, tensile and elastic modulus, static and fatigue strength, elongation, and hardness properties against the threshold and goal targets provided by the Naval Air Warfare Center Aircraft Division (NAWCAD). Model powder deposition parameters. Prepare a report to ONR and NAWCAD on design(s) and modeling and prepare a Phase II testing plan.

PHASE II: Construct a prototype non-helium cold spray system and assess the material properties of the deposition of aluminum 7050-T7451, Ti6-4, and AerMet 100 powders. Assess the properties of repaired 7050-T7451, Ti6-4 and AerMet 100 substrates using cold spray-applied powders of the same alloys. Provide a report that documents the design of the prototype system, results of system performance and results of material testing for the three alloys. Provide a Phase III plan to ONR and NAWCAD for prototype evaluation. Provide a prototype non-helium cold spray system to NAWCAD for evaluation.

PHASE III DUAL USE APPLICATIONS: Assemble a full non-helium cold spray system and demonstrate output meeting key deposition and material parameters. Deliver a full non-helium cold spray system to NAWCAD and report containing designs and test data to ONR and NAWCAD. Dual use applications may include light metal repairs in the aviation industry.

REFERENCES:

1. Joint Technology Exchange Group. "JTEG Technology Forum: Cold Spray Repair." https://jteg.ncms.org/jteg-technology-forum-cold-spray-repair/
2. Widener, Christian; Ozdemir, Ozan; and Carter, Michael. "Structural repair using cold spray technology for enhanced sustainability of high value assets." Procedia Manufacturing, Volume 21, 2018, pp. 361-368. https://reader.elsevier.com/reader/sd/pii/S2351978918301719?token=89EDB6C0287F5C6C578F915E2316AC0A49F5458D3B52AB399259F1C0B17E0E0A931F7CD959A0B985B002B2CCACFEB36B&originRegion=us-east-1&originCreation=20221221152929; 10.1016/j.promfg.2018.02.132

3. Champagne Jr., Victor and Helfritch, Dennis. "Critical Assessment 11: Structural repairs by cold spray." Materials Science and Technology, Volume 31, 2015, pp. 627-634. 10.1179/1743284714Y.0000000723
4. Ozdemir, O.C.; Widener, C.A.; Helfritch, D. and Delfanian, F. "Estimating the Effect of Helium and Nitrogen Mixing on Deposition Efficiency in Cold Spray." Journal of Thermal Spray Technology 660, Volume 25, Issue 4, April 2016, pp. 660-671. DOI: 10.1007/s11666-016-0394-8

KEYWORDS: Cold spray, aerospace alloys, non-helium, repair, maintainability, metals

VERSION 7

N232-103 TITLE: Machine Readable Contextual Understanding and Drilldown

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems;Trusted AI and Autonomy

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 the Announcement. 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: Machine reasoning logic and semantic interoperability for contextual understanding, auto-alert cuing, and drilldown of anomalous events and activities in multidomain littoral zones. Domain independent ontologies for seamless unambiguous knowledge representation with spatiotemporal tags and tracks associated with events, entities, relations, and transactions.

DESCRIPTION: Context is considered as any information that can be used to characterize a situation that is relevant to the interaction between entities in their environment, for example, detecting the preparation signs of hostile amphibious warfare or sea-lane blockade. Lack of context significantly hinders effective decision-making, command, and control. Providing context dramatically facilitates accurate interpretation. Contextual understanding allows an increased level of interoperability for human-machine and machine-machine interactions. Effective collaboration requires proper information formats that can be exchanged between devices without a loss of contextual meaning. Decision-makers and analysts supporting naval missions on the Ops-Floor develop actionable intelligence from an extensive array of decentralized multi-intelligence (multi-INT) and Open Source intelligence OSINT data sources varying in size, modalities, velocities, and types (i.e., structured and unstructured data). The challenge is to develop a trusted Artificial Intelligence (AI) perception method that will significantly reduce the Ops-Floor course of action decision timeline to less than an hour (currently it takes about a day) to support Pacific Command Counter Intelligence Surveillance and Reconnaissance and Targeting (PACOM C-ISRT) or Joint Interagency Task Force (JIATF)-South counter-narcotics operations.

Distributed systems today often use the Web Ontology Language (OWL) as a mechanism to convey the meaning and context of information sources. OWL allows for the description of classes and logical relationships in an ontology for use by machines. OWL is used to explain references and descriptions in a data feed, encoded using the Resource Description Framework (RDF). RDF is extensively used in Business-to-Business e-commerce exchanges. It provides a mechanism to explain the precise meaning of particular parts of an XML chain concerning conventional definitions.

Based on this success, several prototypes have sought to extend the methodology for use in distributed analytic applications in the defense community. So far, the success has been limited to applications that use a relatively static ontology. A rapid change in ontology makes it difficult for constituent systems to adhere to a set of representations of context and the meanings that will change quickly. For example, machine-readable ontologies have worked well in pharmaceutical fields where the underlying DNA strands are relatively stable over time or in the air traffic controls where the flight rules do not change. However, when applied to specific military activities like monitoring the enemy's course of action, the ontologies require a precise method to update and synchronize across relevant distributed systems. Each system manages its ontology while requiring significant software development to transform information at system boundaries. By doing so, risking a considerable loss of information during the transfer that leads to incorrect analysis.

Note 1: Work produced in Phase II may become classified. 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 have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain an appropriate security-level facility and Personnel Security Clearances to perform on advanced phases of this project as set forth by DCSA and ONR to gain access to classified information about 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 advanced phases of this contract.

Note 2: Phase I will be UNCLASSIFIED and classified data is not required. For test and evaluation, an awardee needs to define the ground truth for the scenarios and develop a storyboard for each to guide the test and evaluation of this SBIR technology in a realistic context. Supporting datasets must have acceptable real-world data quality, content, and complexity for the case studies. For example, an image/video dataset of at least 4000 collected images and frames for a case study is considered content rich.

Note 3: Awardees must provide appropriate dataset release authorization for use in their case studies, tests, and demonstrations. They must certify that there are no legal or privacy issues, limitations, or restrictions with using the proposed data for this SBIR project.

PHASE I: Machine contextual understanding or “perception” will consist of four key functional components: 1) contextual multi-INT/OSINT data acquisition and content recognition (i.e., video, multispectral imagery, audio, text), 2) contextual learning and representation (“modeling”), 3) contextual reasoning and classification logic, and 4) contextual human-machine collaboration and query. Develop an ontological framework consisting of “Scene Ontology” and “System Ontology” for cross-domain contextual representation that enable rich context expressions and strong validation. Develop geospatial models to represent the physical space and location of the entities and sensors with spatiotemporal ontologies expressing contextual information. Develop knowledge graphs to reason over multimodal data sources for latent contextual feature representation of entities and relations. In other words, the ontological reasoning logic must overcome data impurities and scene ambiguities manifested through spoofing, deception, clutter, and noisy environments.) Develop question-answering methods to probe, query, and share machine spatiotemporal contextual insights. Develop three compelling maritime cross-domain scenarios of naval concerns. Develop each scenario with at least ten complementary events that evolve. Demonstrate the extendibility of the ontologies.

Phase I baseline performance metrics for evaluating machine perception algorithms against the multimodal datasets (video, multispectral imagery, audio, text) are:

- Machine Performance Accuracy: Structured Data Translation and Distillation - Accuracy 90% over 95% captured content; Unstructured Data Translation and Distillation – Accuracy 85% over 90% captured content.
- Precision: Proportion of retrieved machine perception material that is relevant; Precision = TP/(TP+FP), True Positives (TP) and False Positives (FP). Maximizing Precision minimizes FP.
- Recall: Proportion of relevant perception material that is retrieved; Recall = TP/(TP+FN), False Negatives (FN). Maximizing Recall minimizes FN.
- Fi Measure = [(1+i2) x Precision x Recall] / [i2 x Precision + Recall]; allows variation of Fi to shift importance of Precision vs. Recall, e.g., F0.5: makes Precision more important; F1: balances the Precision and Recall; F2: makes Recall more important.

• Novelty: Precision and recall having same values but calculated for novel information retrieved.
• Accurate Perception Retrieval Rate = (TP+TN)/(TP+TN+FP+FN); True Negatives (TN).
Deliverables (in addition to standard Phase I contract deliverables): end-to-end initial prototype technology, T&E, demonstration, a plan for Phase II, and a final report.

PHASE II: Develop a prototype software and supporting hardware system incorporating the candidate technologies from Phase I. Incorporate the three scenarios developed in Phase I with representative operational data sources for the prototype design. Demonstrate synchronization of at least ten disparate data-feed streams in real-time, with relationship information relevant to mission scenario models. Apply datasets provided by the end-users (i.e., Pacific Fleet [PACFLT] or JIATF-South) for Phase II development. This will show a well-established relationship for a potential transition. By the end of Phase II, validate and verify the overall technology performance against the end-user-defined tests, evaluations, and demonstration benchmarks. Test and demonstrate the prototype software against the benchmark datasets. Validate and verify the overall accuracy of software tools based on the performance metrics detailed for Phase I in addition to the following performance enhancement metrics. Phase II Machine Performance Accuracy: Structured Data Translation and Distillation - Accuracy 95% over 95% captured content; Unstructured Data Translation and Distillation – Accuracy 90% over 95% captured content. Demonstrate that Ops-Floor end-to-end processing and execution timelines are in-step with operational requirements. Develop a plan for Phase III with a transition path to a program of record. Deliverables: prototype software, systems interface requirements for mobile and stationary devices, design documentation, source code, user manual, and a final report.

Note 4: It is highly likely that the work, prototyping, test, simulation, and validation may become classified in Phase II (see Note 2 in the Description for details). However, the proposal for Phase II will be UNCLASSIFIED.
Note 5: If the selected Phase II awardee(s) does not have the required facility certification for classified work, ONR or the related DON Program Office will work with the awardee(s) to facilitate certification of a related facility.

PHASE III DUAL USE APPLICATIONS: Advance these capabilities to TRL-7 and integrate the technology into the Maritime Tactical Command and Control POR or Intelligence, Surveillance, and Reconnaissance (ISR) processing platforms at Marine Corps Information Operations Center. Once validated conceptually and technically, demonstrate dual use applications of this technology in the financial/banking sectors and relevant data centers.

This technology has broad applications in government and private sectors to monitor and discover unlawful transactions, commerce, and national security threats. In government, it has numerous applications in military, intelligence communities, law enforcement, homeland security, and state and local governments to counter a variety of threats or natural crises. In the commercial sector, the technology has applications in the healthcare industry, financial sectors, and security services.

REFERENCES:
1. Li, Y.; Li, W. and Nie, L. “Dynamic Graph Reasoning for Conversational Open-Domain Question Answering.” ACM Transactions on Information Systems, Vol. 40, Issue 4, Article No. 182, October 2022, pp. 1-24. https://dl.acm.org/doi/10.1145/3498557
2. Mehrabi, N.; Morstatter, F.; Saxena, N.; Lerman, K. and Galstyan, A. “A survey on bias and fairness in machine learning.” ACM Computing Surveys, Vol. 54, Issue 6, Article No. 115, July 2021, pp.1-35. https://dl.acm.org/doi/abs/10.1145/3457607
3. Cai, Z. and Vasconcelos, N. “Cascade R-CNN: High Quality Object Detection and Instance Segmentation.” IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 43, Issue 5, May 2021, pp. 1483-1498. https://ieeexplore.ieee.org/document/8917599

VERSION 7

4. Gao, J.; Sun, C.; Yang, Z. and Nevatia, R. “Tall: Temporal Activity Localization via Language Query.” IEEE International Conference on Computer Vision, August 2017, pp. 5277-5285. https://openaccess.thecvf.com/content_ICCV_2017/papers/Gao_TALL_Temporal_Activity_ICCV_2017_paper.pdf

KEYWORDS: Machine-Contextual-Learning; Machine-Recognition; Contextual-Reasoning; Contextual-Understanding; Machine-Perception; Classification-Logic

VERSION 7

N232-104 TITLE: Mid-Wave Infrared Detectors with Tunable Narrow-Band Spectral Response

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 the Announcement. 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 mini-array of optical detectors that combine narrow spectral response (= 200 nm) with enhanced specific detectivity for all polarizations, and which can be tuned across at least 500 nm of the 3 – 5 µm midwave infrared (MWIR) spectral band.

DESCRIPTION: Navy requirements for advanced MWIR and longwave infrared (LWIR) detectors have typically been subdivided into two application classes. The first is broadband thermal imaging by a focal plane array (FPA), to provide high-resolution vision and identification in near or total darkness. This requires a broad spectral bandwidth that maximizes the net signal within a given atmospheric window such as the MWIR (3-5 µm) or LWIR (8-12 µm). Cryogenics are generally required to reach background-limited performance (BLIP). The second application class requires high sensitivity only within a narrow spectral bandwidth. This occurs when the signal to be detected is produced by an infrared (IR) laser or for passively detecting optical emission at known spectral lines. Examples include active imaging, multispectral/hyperspectral imaging, target designation, free-space communications, laser spectroscopy for chemical/biological/explosives sensing, laser/beacon detection, and Light Detection and Ranging (LiDAR).

The goal of this SBIR topic is to combine the benefits of both applications by enabling the development of larger format MWIR detector arrays that have high sensitivity within a dynamically tunable narrow spectral bandwidth. To achieve this goal, the Navy is seeking MWIR detectors that display enhanced specific detectivity (D*) within a narrow spectral bandwidth. This is in direct contrast to the state-of-the-art approach that lowers detectivity through the use of a narrow bandpass filter placed in front of a broadband detector. A further goal is to provide the ability to tune the peak response wavelength while maintaining enhanced D* for applications such as hyperspectral imaging.

One potential approach that could be used to address this problem involves placing a very thin detector absorber region within a resonant cavity tuned to the wavelength bandwidth of interest [Ref 1]. High quantum efficiency is retained due to numerous passes of the incident light through the cavity, while clutter associated with wavelengths outside the spectral region of interest is rejected. The resonant cavity infrared detector (RCID) architecture can also enhance the frequency response, since photogenerated carriers are collected much more rapidly from the very thin absorber. RCIDs are relatively mature at telecommunication wavelengths, where the primary motivation is to maximize the speed for high data rate [Ref 1]. However, RCIDs operating at MWIR wavelengths beyond 3 microns have previously performed poorly compared to conventional broadband detectors. Only quite recently have more encouraging results been reported [Refs 2,3], which confirm a promising pathway to substantial reduction of the dark current noise while maintaining high peak quantum efficiency for enhanced sensitivity within the resonance bandwidth.

A second potential approach is to incorporate a plasmonic metamaterial grating [Refs 4,5]. These architectures can also maintain high quantum efficiency when the absorber is very thin by redirecting the normal-incidence IR signal to propagation in the plane. For grating resonance wavelength in the LWIR, this has led to enhancement of D* in type-II superlattice nBn devices at operating temperatures in the thermoelectric cooler range [Ref 5].

Both RCIDs and plasmonic gratings can enhance D* within a narrow spectral bandwidth by reducing the diffusion current noise generated in the very thin absorber. This may allow both laser detectors and multi-spectral imagers to display background-limited performance at higher operating temperatures than is currently possible, leading to substantial reduction of the size, weight, and power (SWaP) of Navy systems. Both architectures are also suitable for fabricating devices displaying different resonance wavelengths on the same chip, which may potentially provide multi-spectral imaging by scanning a 1D array. Other architectures may allow simultaneous dynamic tuning of the resonance wavelengths of all devices in a 2D array.

Overall goals of this SBIR topic are to: (1) Enhance the sensitivity and overall performance of single-element narrow-band IR detectors for all polarizations of the incident radiation; (2) Demonstrate small arrays with nominal dimensions of at least 4 × 4 or 16 × 1 by the end of Phase II, which can be scaled to a 64 × 64 format mini-camera in a Phase II option and higher format wavelength tunable cameras in Phase III; and (3) Demonstrate controlled tuning of the resonance wavelength over at least 500 nm and return back to the initial wavelength within 0.1 ms, for an effective hyperspectral revisit rate of = 5 kHz.

CLARIFICATIONS:

For those companies who wish to use GFE furnished materials in Phase I, the wafer material offered will be 1/4 wafer of an nBn structure with cut-off wavelength about 5.1 um and 100-nm-thick Ga-free absorber (InAsSb-InAs superlattice), which is grown on a GaSb substrate. No distributed Bragg reflector (DBR) mirror is included as part of the provided wafer material. The material will be delivered no later than 80 days after the beginning of Phase I. If requested, further wafer material can be provided under Phase I option and Phase II to any performer who is awarded contracts for those phases.

PHASE I: Develop a proof of principle approach to fabricating narrow-band (= 200 nm) detectors with tunable resonance wavelength. The design should be capable of reaching D* > 4 x 1011 [cm – sqrt(Hz) / Watt] for a resonance wavelength of 4.5 µm and all polarizations when operated at 200 K. Process and deliver a single fixed-wavelength narrow-band detector for evaluation by the Offeror and/or NRL.
In the Phase I Option, if exercised, demonstrate via experiment and/or modeling the feasibility of a tunable narrow-band mini-array for development in Phase II. The mini-array will have dimensions at least 4 × 4 or 16 × 1, and variable resonance wavelength spanning at least 500 nm of the MWIR band.
In Phase I, MWIR detector wafer materials can be provided by the Naval Research Laboratory (NRL), or the awardee may employ its own source of material.

PHASE II: In the first 18 months of Phase II, optimize D* of the narrow-band MWIR detectors. By the end of Year 2, fabricate and deliver a narrow-band mini-array with dimensions of at least 4×4 or 16×1, and which provides variable resonance wavelength spanning at least 500 nm of the MWIR band. The spectral bandwidth should be = 200 nm, but may be much narrower and its value is optional because different widths are optimal for different applications. Delivery will include a cooler/dewar as needed, electronic controls, and input/output optics. If the awardee chooses to employ detector wafer materials from NRL, those materials can be provided as needed.

PHASE III DUAL USE APPLICATIONS: Fabricate and deliver a narrow-band camera with array dimensions of at least 128 × 128 and resonance wavelength spanning = 500 nm of the MWIR at a rate = 5 kHz. Delivery will include a cooler/dewar, read-out integrated circuit (ROIC), and input/output optics, with input lens providing = 8° field of view. The manufacturing technology for producing the array should be at least MRL 4 [Ref 6]. The narrow-band arrays should be suitable for hyperspectral imaging, remote chemical and biological detection, or free space optical communications for DoD missions.

REFERENCES:

1. Meyer, Jerry et al. "Resonant-Cavity Infrared Photodetectors with Fully-depleted Absorbers." US Patent No. 10062794 B2 (2018). https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/10062794
2. Li, et al., "Room temperature detection of N2O using a resonant cavity mid-IR detector and interband cascade LED," Laser Applications to Chemical, Security & Environmental Analysis, (11-15 July 2022, Vancouver), paper LM3B.2, https://opg.optica.org/abstract.cfm?uri=LACSEA-2022-LM3B.2.
3. Canedy, Chadwick L. et al. "Resonant-cavity infrared detector with five-quantum-well absorber and 34% external quantum efficiency at 4 µm." Opt. Express 27, 2019, pp. 3771-3781. https://opg.optica.org/oe/fulltext.cfm?uri=oe-27-3-3771
4. Jackson, E.L. et al. "Two-dimensional plasmonic grating for increased quantum efficiency in midwave infrared nBn detectors with thin absorbers." Opt. Express 26, 2018, pp. 13850-13864. https://opg.optica.org/oe/fulltext.cfm?uri=oe-26-11-13850&id=389666
5. Nordin,L. et al."High operating temperature plasmonic infrared detectors." Appl. Phys. Lett. 120, 101103, 2022. https://aip.scitation.org/doi/10.1063/5.0077456
6. Wikipedia. "Manufacturing readiness level." https://en.wikipedia.org/wiki/Manufacturing_readiness_level

KEYWORDS: MWIR, resonant cavity devices, plasmonic metamaterials, laser detection, spectroscopy, remote sensing

N232-105 TITLE: Liquid Crystal on Silicon (LCoS) Micro-Displays for Deep Learning Acceleration

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Trusted AI and Autonomy

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 the Announcement. 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: Research, develop, and fabricate micro-scale, high-resolution, high-refresh rate liquid-crystal-on-silicon (LCoS) micro-displays.

DESCRIPTION: The Office of Naval Research (ONR) is currently developing a range of electro-optical compute accelerators (EOCAs) for small-scale, low-power, lensless computer-vision applications. To create the next-generation versions of EOCAs, we are seeking proposals aimed at the fabrication of custom liquid-crystal micro-displays. We are interested in micro-scale, high-resolution liquid-crystal displays, similar to what would be found in commercial virtual-reality headsets.

The micro-displays we need have several requirements not found in existing commercial offerings. Some additional research is hence needed. The micro-displays must be small (20 millimeter diagonal length or less) and high resolution (2048x1080 pixels or higher). The micro-displays should be grayscale-only and capable of supporting and implementing 8-bit grayscale values with the option to potentially support 16-bit values. A low response time (about 3 milliseconds or lower), and hence high frame rate (240 frames per second or higher), is needed to perform sensing and processing tasks at a level needed for realizing certain autonomy capabilities. The micro-displays should also come in back-lit and non-back-lit, transparent variations. In the latter case, the display should be made as transparent as possible so that light can travel through the liquid-crystal layer and be predominantly attenuated by the point-spread functions that will be shown on them. The EOCAs will have active-pixel sensors placed almost immediately behind the transparent liquid-crystal layer of the micro-displays, so no occluding materials can be present; any electronics should be located at the periphery of the displays and incorporated into the baffling. Both the back-lit and non-back-lit, transparent displays should interface with printed-circuit driver boards that will be developed and fabricated by the awardee as part of this SBIR topic.

Design Requirements:

- Size: < = 20 millimeter diagonal length
- Resolution: > = 2048x1080 pixels
- Display Color: Monochromatic
- Refresh Rate: > = 240 frames per second
- Pixel Bit Depth: > = 8 Bits
- Cell Gap Uniformity: < = 5%
- Back-lit Display Brightness: > = 1000 candela per square meter
- Interface(s): Multi-lane Mobile Industry Processor Interface (MIPI DSI) with High-Definition Multimedia Interface (HDMI) 2.1, or better, to provide inputs to the printed-circuit driver board

Technical challenges: Ideally, the displays should be as low power as possible. An integrated driver will likely be necessary to achieve power draws of under 400 milliwatts while the display is active. The

displays may be used for applications in harsh environments not currently considered by the acquisition program. A path forward for high-temperature operating conditions (greater than 70 degrees Celsius) should be established in the design stage, even if it is not implemented in the prototypes.
Supporting incredibly high frame rates will not be feasible with present HDMI standards. Pre-buffering many image frames may not always be an option. The displays will hence, practically, be limited to the rates and resolution supported by the current HMDI 2.1/2.1a standard, which will be approximately 240 frames per second, during evaluation by the Navy. The designed displays will eventually be merged with a custom application-specific integrated circuit (ASIC) chip to drive them at the highest frame rate offered by a multi-lane MIPI connection.

PHASE I: Produce a LCoS design that satisfies the above criteria. If the design cannot meet the design objectives an analysis or discussion of the potential should be included in the Phase I report. Modeling, simulation, or comparison to similar developments should be used to justify design decisions.

PHASE II: Fabricate two to three prototype systems for evaluation. The prototype demonstration should achieve or show potential for meeting the design requirements. Perform detailed analysis on ruggedness and compatibility with Navy unmanned underwater vehicle handling, storage, and environmental operating conditions. Testing will be conducted by both the performer and by Navy personnel. Cost effectiveness and manufacturability feasibility should be addressed as part of the prototype test and evaluation. The appropriate acquisition program office will be consulted for any additional evaluation metrics needed for Phase III.

PHASE III DUAL USE APPLICATIONS: Build an advanced LCoS prototype that meets appropriate technology readiness level (TRL) metrics set by the acquisition program office. Support the Navy for test and validation of the system for certified Navy use. Explore the potential to transfer the LCoS technology for commercial use. Commercial applications might include visual detection and tracking systems, low-power processing for commercial UxV systems, and large-scale supercomputing resources. Develop manufacturing plans to facilitate transition to a UUV program of record.

REFERENCES:

1. Yang, J.P.; Wu, J.P.; Wang, P.S. and Chen, H.M.P. "Characterization of the spatially anamorphic phenomenon and temporal fluctuations in high-speed, ultra-high pixels-per-inch liquid crystal on silicon phase modulator." Optics Express, 27(22), 2019, pp. 32168-32183. DOI: 10.1364/OE.27.032168
2. Pivnenko, M.; Li, K. and Chu, D. "Sub-millisecond switching of multi-level liquid crystal on silicon spatial light modulators for increased information bandwidth," Optics Express, 29(16), 2021, pp. 24614-24628. DOI: 10.1364/OE.429992
3. Yang, H. and Chu, D.P. "Phase flicker in liquid crystal on silicon devices." Journal of Physics: Photonics, vol. 2(3): 032001, 2020, pp. 1-19. DOI: 10.1088/2515-7647/ab8a57

KEYWORDS: Liquid-Crystal Display, Optical Processing, Machine Learning, Computer Vision, Deep Network, Frame Rate

N232-106 TITLE: Machine Learning Database to Guide Development of Low Flammability Polymer Matrix Composites

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment;Trusted AI and Autonomy

OBJECTIVE: Develop an active machine learning (ML) database to aid the Navy in the development of polymer matrix resins and composites that have low flammability. as demonstrated under ASTM E1354 (heat release rates) by cone calorimeter. The Navy has very strict flammability requirements for composite materials to qualify for use below deck (MIL-STD-2031), which must meet metrics for time to ignition, maximum heat release rate, and smoke density (IAW ASTM E662).

DESCRIPTION: Use of polymers and composites below deck on a ship is very limited because the polymer matrix resins potentially provide fuel to a fire. Use of composites in general could save weight and reduce maintenance. In applications such as pressure vessels, there is potential to save costs as well. However, the epoxy matrix resins typically used are too flammable and the composite vessels will not meet Navy flammability requirements. Polymer resins that have reduced flammability typically leave more char when burned. They are highly crosslinked materials that are brittle and must be cured at higher temperatures making them more expensive than metal pressure vessels. Addition of flame retardants to the epoxy resins can reduce their properties.

A composite is a system composed of a matrix resin, reinforcement, and possibly other additives. The reinforcements and additives can improve the flammability performance of the composite by restricting oxygen flow to the resin as an inert filler or as an active filler promoting the formation of a blocking layer. The mechanical properties of a polymer composite (i.e., modulus, strength) can be predicted based on resin properties, fiber/filler properties, and fiber volume fraction and orientation. Addition of flame retardants provides a new variable as generally these decrease mechanical properties, though some types could enhance properties.

Working through these variables to identify composites systems that could be used below the deck on Navy ships has proven to be difficult. A ML database could help and could make use of the fairly plentiful data on composites as building materials to predict avenues for the Navy to pursue.
ML databases can be constructed such that they can take many inputs, either experimental or computational, which may be used directly as descriptors to correlate to a desired predicted property, or used to calculate a descriptor through physical or empirical relationships. It is a learning process to see which descriptors yield or correlate to predicted properties which best match experimentally determined properties. When this happens, then reverse design is possible. With this learning process in mind, we would like to start at a fairly simple level with composite component materials on the input side and Navy performance metrics on the output side to evolve an effective ML database for composite materials with low flammability that meet Navy performance needs (modulus, strength, thermal stability). Work will start in Phase I with trying to estimate the flammability of a composite. The Navy has performance requirements based on ASTM E1354 testing with limits given in MIL-STD-2031 [Refs 1-2].

PHASE I: Develop an expandable ML platform that can use: (1) literature data and; (2) first principle calculations to predict the flammability index from the chemical structure of a neat resin. Develop an approach toward predicting ASTM E1354 Cone calorimetry results for maximum heat release rate, time to ignition, and smoke density.

PHASE II: In year one of the Phase II, composite properties will be added based on typical glass fiber and carbon fiber compositions/geometries/volume loading of Navy composites and commercial structural composites. In consultation with the Navy, neat resin and composite samples will be tested to ASTM E1354 and the data will be used to both evaluate the ML database and to add to it. In year two of the

Phase II, common flame retardants will be added to neat resins and composites in a second round of ASTM E1354 testing, again to test this capability of the ML database and to add to it. In Phase II Option, if exercised, mechanical properties of the composites with resin/fiber/flame retardants could be added or other ML database maturation based on discussions with the Navy team.

PHASE III DUAL USE APPLICATIONS: Make the system user friendly, allowing the users to add their own databases and to prioritize various data sources already incorporated into the model. Transition the platform to the technical warrant holder for flammable structural materials and to material engineers trying to improve materials.

The database is dual use as low flammability structural materials are needed for commercial and residential buildings, for aircraft and automobile interiors, and other applications in addition to being used on pressure vessels, storage tanks, hatch doors, and so forth below deck on Navy ships.

REFERENCES:

1. "MIL-STD-2031 Fire and Toxicity Test Methods and Qualification Procedure for Composite Materials Systems Used in Hull, Machinery, and Structural Applications inside Naval Submarines." http://everyspec.com/MIL-STD/MIL-STD-2000-2999/MIL-STD-2031_22305/
2. "ASTM E1354-22b Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter." https://www.astm.org/e1354-22b.html
3. ASTM E662-21ae1 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials." https://www.astm.org/e0662-21ae01.html

KEYWORDS: ASTM E1354; composite; heat release rate; machine learning; database; flammability

VERSION 7

N232-107 TITLE: Shipboard Carbon Capture and Storage

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

OBJECTIVE: Develop and demonstrate methods to capture carbon dioxide emissions from a ship's exhaust and store it onboard until it can be offloaded.

DESCRIPTION: The Department of the Navy's recently released strategy, Climate Action 2030 [Ref 1], established aggressive targets to reduce Department-wide emissions of greenhouse gases. Despite recent advances in energy efficient technology, the Navy is still heavily reliant on fossil fuels for propulsion and power generation on its ships and aircraft, with surface ships consuming more than 12 million barrels of marine diesel annually. Achieving net zero emissions will require a combination of approaches including alternative fuels, increased hybridization, and direct carbon capture both on installations and at-sea. The latter requires adaptation of stationary carbon capture technology for shipboard application. A number of post-combustion carbon captures technologies have been employed in terrestrial power plants, with chemical adsorption being the most mature. Exhaust gas is first cooled, passed through a filter, and then reacted with the absorbent, typically an amine-based solvent, to separate carbon dioxide before the exhaust is released to the atmosphere. The absorbent then goes through a regeneration process in which the CO2 is released by heating, and the absorbent is recycled to the absorption process. In addition to requiring large machinery, the solvents are toxic and can degrade in the presence of other components common to a marine exhaust. Adsorption of CO2 into a solid matrix can alleviate the need for such solvents, but is less selective as absorption. Membrane separation systems are potentially more compact and efficient, but long-term durability has not been demonstrated. Another challenge is shipboard storage of the captured CO2. Storage in gaseous form is often not practical due to space requirements and conversion to liquid or solid require significant power.

Innovative research is sought to develop compact approaches to capture and store carbon directly from shipboard exhaust, while minimizing impact to current ship systems. Systems resulting in a net reduction in carbon emissions greater than 75% are sought, while minimizing impact on efficiency. Net carbon reduction includes extra emissions from power needed to run the system. The most common propulsion system used in Navy surface combatants is F76 fueled LM2500 gas turbines that produce up to 150 lbs/s of 1050 °F exhaust. The system must be able to store at least two weeks' worth of removed carbon for transfer during ship refueling. Storing captured CO2 as a liquid or solid (dry ice) has significant volumetric advantage, but requires additional power. Possible alternatives such as liquid mixtures or mineral carbonization could be evaluated.

PHASE I: Develop an innovative, compact, and energy efficient approach to capture and store carbon dioxide from post-combustion exhaust from a gas turbine engine typical of Navy surface combatants. Analyze the size, weight, and power consumption of complete system. Perform an initial estimate of system cost.

PHASE II: Demonstrate a working prototype of the system sized at least 1/50th of an LM2500 exhaust at full power. Experimentally validate the unit's performance over a variety of exhaust conditions. Assess operational impacts of proposed technology. Complete a cost and scalability analysis of full-scale system.

PHASE III DUAL USE APPLICATIONS: Optimize the concept design for manufacturability, performance, and military requirements using the knowledge gained during Phases I and II. Perform a detailed integration study for installation on a Navy surface combatant. Develop a commercialization strategy for dual use on commercial maritime vessels.
The system could be used in commercial maritime vessels.

VERSION 7

REFERENCES:

1. "Climate Action 2030." https://www.navy.mil/Portals/1/Documents/Department%20of%20the%20Navy%20Climate%20Action%202030.pdf
2. H. J. Herzog, "Carbon Capture." The MIT Press, 2018. https://doi.org/10.7551/mitpress/11423.001.0001
3. StenaBulk. "Is Carbon Capture on Ships Feasible?" Oil and Gas Climate Initiative, 2021. https://www.ogci.com/wp-content/uploads/2021/11/OGCI_STENA_MCC_November_2021.pdf
4. "Carbon Capture, Utilization and Storage." American Bureau of Shipping, 2021. https://absinfo.eagle.org/acton/attachment/16130/f-cbf14a3c-5c56-4203-8ccf-e29fd6d28c68/1/-/-/-/-/carbon-capture-whitepaper.pdf
5. Life Cycle Engineering. "Marine Carbon Capture Technology Review." MARAD report DOC-G0036-0006, Document # DOC-G0036-0006, 24 October 2022. https://www.maritime.dot.gov/innovation/meta/lce-carbon-capture-storage
6. H. Al Baroudi, A. Awoyomi, K. Patchigolla, K. Jonnalagadda, and E.J. Anthony, "A review of large-scale CO2 shipping and marine emissions management for carbon capture, utilisation and storage." Applied Energy 287, 116510, 2021. https://doi.org/10.1016/j.apenergy.2021.116510
7. P. Zhou and H. Wang, "Carbon capture and storage - Solidification and storage of carbon dioxide captured on ships." Ocean Eng 91, 2014, pp. 172-80. https://doi.org/10.1016/j.oceaneng.2014.09.006

KEYWORDS: climate; carbon capture; combustion, absorption, membrane separation

VERSION 7

N232-108 TITLE: Low-Cost Electronic Warfare Training Hardware

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems;Sustainment

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 the Announcement. 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 low-cost hardware to remotely manipulate command and control (C2) gear to mimic Electronic Warfare (EW) attacks during Marine Corps training and exercises, especially those conducted in home station.

DESCRIPTION: Infantry Marines at Battalion level and below do not have organic training capabilities for EW. A key problem is the availability and affordability of EW training equipment that can be used by the units or support organizations conducting training scenarios. These training scenarios need to include realistic EW effects but are prevented in many cases due to classification or restrictions involved with employing actual attacks.

A low-cost remotely controlled hardware device which can mimic different EW attack effects is desired. Devices should easily interface with operational equipment such as tactical radios, GPS, networking gear, and computers. The device shall be interoperable with, and not hinder, range control and other communication and position location identification (PLI) systems that link and integrate other safety networks. The device should be man-portable, or transportable by an unmanned system (e.g., ground) and be capable of supporting a 5-day training event within a mission duration of 8 hrs/day. External power and different levels of activity mode (e.g., active, sleep, etc.) may be used to address training timeframe. Ideally, the total system cost is below $1,500. Control of the device should be enabled via standard Internet Protocol (IP) network messaging (e.g., Transport Control Protocol / User Datagram Protocol) on a separate network (wired or wireless) from tactical gear and support machine to machine control from other systems. Documented control interfaces to allow third-party control, integration, and testing (e.g., software API) must be provided with prototypes. Specifically, the goal is to enable remote management of the device to allow scenario managers or adjuctors/referees the ability to simulate EW effects on the training unit. Examples of attacks to be mimicked include jamming, deceptive signal broadcast, and data injection. Candidate solutions may be based on low-power close-in electromagnetic emmisions or hardware-based signal attenuation (i.e., in-line software-controlled signal attenuation devices), however alternate strategies will also be considered. SBIR submissions should, at a minimum, have capabilities of affecting frequencies supported by AN/PRC117G, including VHF and UHF SATCOM. Candidate devices may be reconfigurable or include heterogeneous components to enable compatibility with alternate frequencies or waveforms. The overall expectation is that a number of prototypes would be used to create an affected area in which the training unit would experience synthetic EW effects realistic enough to enhance training.

PHASE I: Construct a single non-hardened prototype device to support at least one attack vector. Attack vectors include, but are not limited to, jamming, deceptive signal broadcast, and data injection. Research and market analysis documentation generated by SBIR performers will be evaluated in partnership with transition office, ONR SBIR technical POCs, and training communities evaluate and prioritize attack vectors and methods during early technical development phase.

Prototype device will demonstrate ability to generate electromagnetic (EM) signals or EW capability that mimics realistic effects within training community objectives. For example, EM Signals will match characteristics of realistic operational equipment (i.e., signal waveform) at an acceptable emission power level that will allow training range or home station EW sensing training (Order of Magnitude emission power should be greater than 1 Watt and no more than 50 Watts). Multi-waveform emission capability via Software Defined Radio or similar technology (e.g., FPGA) that demonstrates multi-role utility is preferred for low-power emmision devices. Components of prototype and production process should reflect technical and manufacturing approach that will enable cost per unit objective (below $1,500), however, higher costs reflecting greater system capability or adaptability are also acceptable. Prototype will be able to operate on battery power enabling long-duration standby (but can be supplemented by shore power for extended use). Ideally, the system would be compatible with program of record USMC battery or standalone electricity systems (e.g., 2590 batteries or SPACES-II solar kit). Prototype kit should be man-portable (i.e., hand-carry), fitting into a common 'briefcase sized' protective case (e.g., Pelican 1550 or similar).

PHASE II: Construct training-ready (i.e., hardened) devices that support multiple EW attack or signal effect vectors.

Prototype will demonstrate downstream capability to network with program of record exercise control systems in distributed manner (i.e., multiple devices can be controlled at once), and provide sense/replay capabilities (if applicable) to be executed within training-relevant timelines (i.e., processing for replay fast enough to enable tactical mimic of signals). Prototype will be hardened physically and electromagnetically to meet acquisition-office deployment requirements (i.e., field-deployable with modest adjustments). Hardware will demonstrate ability to operate in the field within training-relevant timelines (hours-days+) in low-power mode to extend training time. Hardware will demonstrate ability to receive control messaging with existing exercise control (EXCON) systems via stakeholder selected IP-based messaging protocol to enable centralized control of many devices from a central EXCON station. Software controls enable dynamic control of signals to align with mobile training unit (i.e., emit power can be controlled to enable dynamic jamming effects, different frequencies for emission and waveform can be selected). Hardware configuration includes approvable sources electronics (i.e., no blacklisted hardware). Vendors will work with government identified program of records such as Marine Corps Live Virtual Constructive-Training Environment, Electromagnetic Warfare Ground Instrumented Range, and potential others.

PHASE III DUAL USE APPLICATIONS: Establish at-scale manufacturing pipeline able to produce EW training hardware devices in limited runs. Demonstrate production equipment using approved components, software ATO, etc. Contracting method with the appropriate acquisition office established to enable purchase of standalone units (or block-purchases). LVC-TE program able to purchase equipment to field tied into selected next-generation range communication systems (e.g., 5G backhaul).
Outside of the DoD Marine Corps Infantry end user population, it is expected that the hardware developed under this SBIR topic can be used for testing or training by mimicking EM signals produced by civilian infrastructure. Potential end users that would be tested and trained include those working within commercial communications – e.g., first responders, cellular provider technicians, and others. Specific tasks may include equipment installation normally requires load-testing and interference testing during installation to characterize network performance envelope – this hardware can create realistic representation of single or multi-band users by generating signals within civilian frequency bands. Additionally, the device will be able to create temporary communications-degraded environments on channels used by civilian emergence or disaster-relief response teams. The device would be able to create

a training environment simulating limited or loss communications emulating limited infrastructure expected under a Humanitarian Assistance and Disaster Relief scenario.

REFERENCES:

1. MCRP 3-32D.1 Electronic Warfare
2. Communication Equipment B191716 Student Handout. https://www.trngcmd.marines.mil/Portals/207/Docs/TBS/B191716%20Communication%20Equipment.pdf
3. Joint Publication 3-85 Joint Electromagnetic Spectrum Operations, 22 May 2020. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_85.pdf?ver=2020-07-21-114233-010
4. Haystead, John. “Staying the Course – Maintaining the Path to Advanced Marine Corps EMSO.” Journal of Electromagnetic Dominance. https://www.jedonline.com/2022/09/07/staying-the-course-maintaining-the-path-to-advanced-marine-corps-emso/
5. L3Harris Falcon III AN/PRC-117G(V)1(C) Multiband Networking Manpack Radio Datasheet https://www.l3harris.com/resources/anprc-117g-multiband-manpack-datasheet

KEYWORDS: Training; Electronic Warfare; Marines

VERSION 7

N232-109 TITLE: Data Exfiltration and Communication Architecture for Cooperative, Autonomous, Underwater, Long-endurance Sensors

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy

OBJECTIVE: Develop a communication and data exfiltration architecture with related algorithms to support a spatially-distributed and depth-varied field of long endurance Underwater Autonomous Sensors (UAS) operating in a cooperative network in an ocean environment.

DESCRIPTION: Long endurance, autonomous sensors such as gliders, profiling floats, sonobuoys, and Autonomous Underwater Vehicles (AUVs) continue to provide critical measurements in oceanographic surveys and experimentation. Individually, these sensors can be deployed to provide a basic understanding both spatially and temporally of oceanographic phenomena. However, a comprehensive underwater monitoring approach would be possible if a fleet of autonomous, underwater sensors were capable of underwater communication, networking, and cooperatively exfiltrating data back to a central node/platform for aggregation. This SBIR topic takes advantage of continued technological advances in communication networks and autonomous systems to develop algorithms for UAS synchronization and communication architectures. The objective is to develop a communication and data exfiltration architecture with related algorithms to support a spatially-distributed and depth-varied field of long endurance UASs operating in a cooperative network in an ocean environment. The architecture should be sensor-agnostic to allow for synchronization and communication between multiple platform types (e.g., Sonobuoy to glider). The algorithms should assume 10s to 100s of sensors at multiple depths, which can span from 60 ft. to > 1500 ft. and spatially separated by 1-10nmi between platforms with a data exfiltration component to specialized nodes. Initial data collected and communicated should include latitude, longitude, pressure, and temperature with future options including acoustic data. A-sized sonobuoys will function as the initial platform for algorithm and physical architecture development. The proposed prototype hardware that will host the developed algorithms must be subject to the size (< 1100 cu in.), weight (< 24 lbs.), and power requirements to fit in the lower unit of a traditional A-size sonobuoy.

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 Counterintelligence and Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR 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 advanced phases of this contract.

PHASE I: Develop the initial concept design and algorithms, and model key components to demonstrate proof of concept. To support multiple potential optimal configurations, indicate the trade/risk space on cost/feasibility/component maturation for capability to achieve a spatially distributed network of UASs at a variety of depths, spacing (1-10nmi), and operational life (8hrs – 14days). Perform an estimate of component costs and fabrication estimates for new technology to be developed in subsequent phases of the effort.

PHASE II: Construct a prototype system based on the Phase I design(s) for demonstration and validation. System development should include development/maturation of the communication and data exfiltration algorithms, as well as prototypes for collection, exfiltration, and aggregation of oceanographic data. Software should rely on open-source languages and libraries. Multiple demonstrations in operationally

relevant environments should be planned, including in coordination with a larger research field exercise with additional autonomous sensors. Prototype(s) should 1) be run in near-real time, 2) test communication and networking at a variety of spatial, temporal, and depth scales/spacing, and 3) validation criteria include accuracy, latency, and processing time. Upon completion of Phase II, the prototype(s) and a technical report outlining function and validation/verification of performance should be delivered to the Department of Navy (DON) ready for demonstration at sea.
Work in Phase II may become classified. Please see note in Description section.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will align with the program of record to integrate the results of the Phase II work. This includes manufacture of multiple units, incorporation of algorithms to systems (where feasible), and adjusting requirements based on needs of the operational environment.

Dual-use applications include coordination with other governmental partners for oceanographic monitoring and data collection (such as National Oceanic and Atmospheric Association (NOAA)), university partners using data for pedagogical and/or research purposes, and industry partners with needs for autonomous, underwater monitoring or survey.

REFERENCES:

1. Ferri*, G., Munafò*, A., Tesei, A., Braca, P., Meyer, F., Pelekanakis, K., & LePage, K. (2017). Cooperative robotic networks for underwater surveillance: an overview. IET Radar, Sonar & Navigation, 11(12), 1740-1761.
2. Yoon, S., & Qiao, C. (2010). Cooperative search and survey using autonomous underwater vehicles (AUVs). IEEE Transactions on Parallel and Distributed Systems, 22(3), 364-379.
3. The Ears of Air ASW: A History of U.S. Navy Sonobuoys. Navmar Applied Sciences Corporation, 2008

KEYWORDS: environmental monitoring; cooperative network; Underwater Autonomous Sensors; distributed field; underwater monitoring; sonobuoys

N232-110 TITLE: Multidirectional, Multifrequency Ship-based Meteorological Satellite Receiver Using a Virtual Gimbal

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems;Space Technology

OBJECTIVE: Develop a cost-effective direct broadcast satellite data receiver system with no moving parts (i.e., virtual gimbal), capable of receiving environmental data streams across multiple transmission bands from a shipboard environment in open ocean.

DESCRIPTION: Direct reception of meteorological satellite data in a maritime environment relies on ship-mounted antennae whose directionality is governed by a rotating gimbal. The rotating gimbal is a common point of mechanical failure for these antennae. While at sea and when broken, there may not be spare parts to repair and restore the gimbal to restore functionality. Further, older antennae may not be equipped to receive at frequencies commonly used by the legacy as well as the latest generation meteorological satellites (typically L through X bands). Such data are high value for operations and their absence diminishes overall performance. This SBIR topic takes advantage of continued technological advances and miniaturization of electronics to reexamine new, cost-effective methods to reliably receive satellite-based meteorological data feeds across multiple frequencies.

The objective is to develop an innovative multiband antenna whose directionality is governed by a virtual gimbal to help reduce incidences of mechanical failure and broaden the pool of available data. The antenna should have no moving parts, be reasonably maintainable with off-the-shelf parts, and be capable of operating in a seaborne environment. This includes accounting for reasonable size, weight, and power requirements and operating on a moving vessel subject to wind and waves. The antenna should receive at a reasonable subset of microwave downlink bands to receive meteorological satellite data broadcasts. A data rate of up to 40 Mbps is required to facilitate representative Joint Polar Satellite System (JPSS) direct broadcast and Geostationary Operational Environmental Satellites (GOES) Rebroadcast capabilities. The antenna should receive Level 0 satellite data in its native format which can then be processed onboard by existing software into a human readable format. Reception of [Advanced] High-resolution Picture Transmission data ([A]HRPT) from the National Oceanic and Atmospheric Administration (NOAA) and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) is encouraged. Design and specifications should also consider direct downlink of novel and future capabilities, such as from commercial weather data vendors and National Aeronautics and Space Administration (NASA) satellites.

PHASE I: Determine technical feasibility of a cost-effective, ship-based direct readout data system using a virtual gimbal able to meet the technological specifications listed in the Description. Develop the initial concept design and model key components to demonstrate proof of concept. To support multiple potential optimal configurations, indicate the trade/risk space on cost/feasibility/hardening for capability to use multiple frequencies and/or wider frequency ranges, various antenna sizes, and windows for viewing the sky including an option to cover all azimuths and altitudes from horizon to zenith. For the top scenarios, perform an estimate of component costs and fabrication estimates for new technology to be developed.

PHASE II: Construct prototype(s) of Phase I design(s) for demonstration and validation. For multiple candidate configurations, clearly indicate comparative criteria for testing and evaluation of final candidate system, including cost, performance, and robustness metrics in real world conditions. For a single candidate configuration, testing thresholds should clearly indicate milestones for evaluating and improving new system technology.

System development should include development/maturation of the direct broadcast hardware system, as well as an end-to-end software prototype for converting received signals into calibrated products that are useable by downstream applications (such as forecaster usage, numerical model ingest). Software should rely on open-source languages and libraries (such as python) and be aligned with current and/or planned production standards for meteorological satellite data in Naval production centers.

Multiple demonstrations in operationally relevant environments should be planned, including in coordination with a larger research field exercise. Prototype(s) should 1) be run in near-real time along with shipborne operations, 2) test reception of multiple satellites at different broadcast frequencies, and 3) validate Level 1/calibrated brightness temperature data records against existing operational sources. Validation criteria include accuracy, latency, and processing time.

Upon completion of Phase II, the prototype(s) and a technical report outlining function and validation/verification of performance should be delivered to the Department of Navy (DON) ready for demonstration at sea.

PHASE III DUAL USE APPLICATIONS: Phase III efforts will align with the program of record to integrate the results of the Phase II work. This includes manufacture of multiple units, alignment of broadcast system into the meteorological operations processing chain, and adjusting requirements based on needs of the operational environment.

Dual-use applications include coordination with other governmental partners for low latency meteorological data (such as USAF, NOAA, and NASA), university partners using data for pedagogical and/or research purposes, and industry partners with needs for improved/cheaper/smaller direct readout of satellite data.

REFERENCES:

1. Wallach, Jeff. “User's Guide for Building and Operating Environmental Satellite Receiving Stations.” U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data and Information Service, 1997. https://noaasis.noaa.gov/NOAASIS/pubs/Users_Guide-Building_Receive_Stations_March_2009.pdf
2. Strabala, K.I.; Gumley, L.E.; Rink, T.D.; Huang, H.L and Dengel, R. “MODIS Direct Broadcast Products and Applications.” Third International Asia-Pacific Environmental Remote Sensing. Remote Sensing of the Atmosphere, Ocean, and Space, April 2003. doi: 10.1117/12.466347
3. Mailloux, R.J. “Phased Array Antenna Handbook, Second Edition.” Artech house, 2005. http://twanclik.free.fr/electricity/electronic/pdfdone11/Phased.Array.Antenna.Handbook.Artech.House.Publishers.Second.Edition.eBook-kB.pdf
4. Ardizzone, E.; Bruno, A.; Gugliuzza, F. and Pirrone, R. “A Low Cost Solution for NOAA Remote Sensing.” SENSORNETS, January 2018, pp. 128-134. https://www.researchgate.net/publication/322874001_A_Low_Cost_Solution_for_NOAA_Remote_Sensing/link/5a78de40aca2722e4df31a59/download
5. DiNorscia, A.; Smith, W. and McNabb, J. “Determining the Ability to Use Direct Broadcast System (DBS) Data to Forecast Severe Weather.” 99th American Meteorological Society Annual Meeting, 2019. https://vsgc.odu.edu/wp-content/uploads/2019/05/Anthony-DiNorscia.pdf
6. Noh, Young-Chan, et al. "Global forecast impact of low data latency infrared and microwave sounders observations from polar orbiting satellites." Remote Sensing 12.14:2193, July 2020. https://www.researchgate.net/publication/342830357_Global_Forecast_Impact_of_Low_Data_Latency_Infrared_and_Microwave_Sounders_Observations_from_Polar_Orbiting_Satellites/link/5f07ef51299bf188161024a0/download

VERSION 7

7. Chen, M.;Fang, X.C.; Wang, W.; Zhang, H.T. and Huang, G.L. "Dual-Band Dual-Polarized Waveguide Slot Antenna for SAR Applications." in IEEE Antennas and Wireless Propagation Letters, Vol. 19, No. 10, October 2020, pp. 1719-1723. doi: 10.1109/LAWP.2020.3014878

KEYWORDS: satellite; receiver; gimbal; antenna; direct readout; direct broadcast; satellite based environmental monitoring; phased array; software defined radio; electronically steered beam

VERSION 7

N232-111 TITLE: Indirect Fire Navigation without GPS or Civilian Infrastructure

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Sustainment

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 the Announcement. 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 low-cost, Indirect Fire Navigation (IFN) architecture that will provide the Navy and Marine Corps with a common, ubiquitous method of all-weather communication and guidance for a Diverse “Community” of Interceptors and Launchers. With respect to existing weapons, the proposed IFN system must have the potential to reduce the size, weight, power, and cost of engagements by an Order of Magnitude with a commensurate increase in the number of simultaneous engagements and stored kills. Moreover, IFN systems must also be capable of network-centric cooperative engagements between platforms with IFN capabilities with the ultimate goal of making “every ship a shooter” and achieving distributed defense among all ship classes.

DESCRIPTION: Existing systems are characterized by large, powerful, and expensive radars, illuminators, missiles, and launching systems. Low bandwidth communications links, single channel illuminators, and volumetrically inefficient magazines limit the ability of these systems to effectively address large, multi-axis raids and project power to ranges beyond line-of-sight. IFN architectures will radically alter these metrics by building on existing technology and applying it to both existing and new weapon systems which have been designed to maximize the benefits of the IFN concept. IFN constructs will support surface to surface and surface to air engagements at long range (over-the-horizon) and must have low size, weight, and power (SWaP) requirements. Concepts shall be applicable to both existing missile and projectile systems and new, compact, low-cost interceptors. The IFN architecture may contain off-board targeting systems and must be capable of accepting a targeting “Cue” from any higher-level Search and Track sensor without consuming additional sensor resources.

Work produced in Phase II will 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 Counterintelligence and Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances. This will allow contractor personnel to perform on advanced phases of this project as set forth by DCSA and ONR 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 advanced phases of this contract.

PHASE I: Conduct a study that develops at least one system concept for IFN meeting the features listed above in the Description. The basic physics of critical elements within the proposed IFN system must be characterized and modeled. Parametric studies are acceptable where performance characteristics vary widely or are unknown. If more than one concept is studied, compare, contrast, and rank the attributes of each and recommend the best path toward further investment, study, development, and experimentation. Prepare a report to ONR detailing the IFN design(s) complete with a Phase II testing plan.

PHASE II: Fabricate and demonstrate brass board versions of key elements in the IFN system developed during Phase I. The system model may require additional fidelity to adequately define the test objectives of Phase II testing, which will measure key metrics affecting system performance. The effort will be classified due to the design and testing of IFN subsystems and critical components demonstrating system performance and matrices. Prepare a report to ONR detailing the results of the Phase II design, fabrication, and testing. Develop a Phase III plan for prototype evaluation.
Work in Phase II will become classified. Please see note in the Description.

PHASE III DUAL USE APPLICATIONS: Design, fabricate, and demonstration test a complete IFN prototype system. Document the design features of the IFN system and the results of demonstration testing in relevant environments associated with Navy and USMC missions. The evolved IFN prototype and Phase III Report will be deliverables to ONR/NSWCDD at the conclusion of each Phase III task. IFN nodes can and should be networked together. As such, they will not only form a support structure for robust communications and engagement systems for self-defense and power projection but also provide a relative navigation system between each node and of the entire network of nodes. As a consequence, dual use opportunities exist for military and civilian applications where there is a need for, as examples, network health monitoring with self-healing, auto-drive, autonomous landing and docking, and collision avoidance.

REFERENCES:
1. Holder, E.Jeff. “Angle-of-Arrival Estimation Using Radar Interferometry.” Sci-Tech Publishing, Raleigh NC, 2014. https://www.worldcat.org/title/angle-of-arrival-estimation-using-radar-interferometry-methods-and-applications/oclc/872685455
2. Johnson, Cale et al. “Organic over-the-horizon targeting for the 2025 surface fleet.” Naval Postgraduate School, Monterey CA, June 2015. https://calhoun.nps.edu/bitstream/handle/10945/45933/15Jun_SEA_Cohort_21_Team_Alpha.pdf?sequence=1&isAllowed=y

KEYWORDS: Low-Cost, Low-Power, Over-the-Horizon (OTH), Network Centric Cooperative Engagements, Guidance and Navigation, self-defense, power projection

VERSION 7

N232-112 TITLE: Electromagnetic Manipulation of Plasma on Hypersonic Reentry Bodies

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics;Sustainment

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 the Announcement. 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: The plasma layer from hypersonic reentry serves to further propagate heat into the reentry vehicles while also increasing its radar visibility and causing what's known as a "communications blackout", a period in which no communications can be exchanged with the vehicle. The Navy seeks to implement developed technologies to manipulate or suppress the effects of environmental plasma with electromagnetic forces to mitigate the environments presented by environmental plasma layers upon atmospheric reentry.

DESCRIPTION: For the future of hypersonic vehicles carrying sensitive payloads into the atmosphere of earth or any other planet, the presence of a communications blackout is of utmost concern. It entails the causes of any catastrophe being rendered unknown, the lack of the period's test data, and limitations in the innovation of reentry vehicles. The obvious candidate for improvement to these vehicles is in expanding upon plasma manipulation; in mitigating or eliminating the plasma frequency on the vehicle's exterior, communications blackout can be mitigated, heat transfer can be reduced, and the craft's electromagnetic signature can be minimized.

These concerns can be alleviated by a system well equipped to manipulate the inevitable accumulation of plasma from surfaces including the aeroshell and antenna window. It's important in this design to consider the importance of mitigating the plasma oscillation effects on outgoing radio signals. Plasma oscillation, or the frequency of electron density oscillations, will control which frequencies may be received by the vehicle's antenna; it's important to consider it a primary goal to mitigate the effects of such a plasma layer by either reducing or eliminating this oscillation of electron density outside the intended emission point of the incoming radio signal, as the only radio frequencies allowed to pass through the plasma layer are those with frequencies higher than the plasma layer's oscillation frequency. Furthermore, a goal of this solution should include the minimizing of plasma density on the exterior of the vehicle.

Considerable research has been conducted on possible systems that can create "windows" in a plasma layer for radio waves to be transmitted through [Refs 1,2]. The utilization of magnetic fields has evidence of being effective in dispersing plasma "sheaths," but the concept of a "magnetic window" has not yet been fully explored [Ref 3].Recently there has been some experiments reducing the plasma sheath using pulsed magnetic fields, however for smaller time frames than what is required for communications [Ref 5].

In the application of magnetic fields for plasma manipulation, weight-conscious designs are imperative for the operation of hypersonic vehicles. The system should be optimized for breadth in radio frequency, quickly-initiated operation sustained for extended periods of time, and minimal load to the vehicle. Proposals are solicited that address the following capabilities:

- Develop plasma manipulation concept implementation for 6-minute atmospheric reentry
- Assessment of other limiting factors and areas of concern

• Design, build, lab test scaled model of plasma manipulation system prototype
Proposed solutions should support the following:
• System operation for up to 6-minute reentry time
• Capable leverage use of existing power supply or the specifications and requirements of an alternative power solution
• MIL-STD-461G (EMI)
• MIL-STD-464D

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 Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP 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 advanced phases of this contract.

PHASE I: Develop a proof of concept of a system that will be able to manipulate or mitigate the effects of a plasma layer so that radio waves can be transmitted uninterruptedly. Model the system's feasibility and energy usage. It should include initial design specifications and capabilities description to build a prototype solution in Phase II if chosen.

PHASE II: Mature the concept system and develop a prototype able to be tested in a laboratory to display the system's capabilities to receive radio communication from beyond the plasma layer. Demonstrate the feasibility of the solution and delay time of effective operation from activation.
It is probable that the work under this effort will be classified under Phase II (see Description for details).

PHASE III DUAL USE APPLICATIONS: Perform detailed design of a scaled plasma manipulation system, validating lab mockup communications through manufactured plasma layer. Develop a process for future use of the framework.

Dual-use applications will entail implementation on hypersonic vehicles, including manned and unmanned spacecraft, requiring safe reentry into planetary atmosphere. Dual use applications include more efficient testing of new exo-atmospheric spacecraft and aerospace technologies, ensuring safety of testing equipment and spacecraft communication devices, and more efficient means of developing advancements to Reusable Launch Vehicles (RLV) and Vertical Takeoff, Vertical Landing (VTVL) spacecraft.

REFERENCES:

1. Kim, Min kwan., Iain D. Boyd, and Michael Keidar, Journal of Spacecraft and Rockets, 2010, Modeling of Electromagnetic Manipulation of Plasmas for Communication During Reentry Flight
2. Kim, Min Kwan, Electromagnetic manipulation of Plasma Layer for Re-entry blackout mitigation, University of Michigan Library, 2009 https://deepblue.lib.umich.edu/handle/2027.42/63784
3. R. A Hartunian, G. E. Stewart, S. D. Fergason, T. J. Curtiss, R. W. Seibold, Causes and mitigation of radio frequency (RF) blackout during reentry of reusable launch vehicles, Reository & open science access portal, 2007-01-26, https://rosap.ntl.bts.gov/view/dot/12493
4. R. Savino, D. Paterna, M. D'Elia, Plasma-Radiofrequency interactions around atmospheric re-entry vehicles: modelling and arc-jet simulation, Semantic Scholar, 10, November, 2010, https://www.semanticscholar.org/paper/Plasma-Radiofrequency-Interactions-Around-Re-Entry-Savino-Paterna/5b8735d083e56716edae9c8723ad35053d6fa468?p2df

5. Jiahao Xu, Xiaoping Li, Donglin Liu, Cong Xu, and Yongqiang Qin, “Density reduction on plasma sheath using pulsed magnetic field”, Physics of Plasmas 28, 042509 (2021) https://doi.org/10.1063/5.0038127

KEYWORDS: Plasma manipulation; Electromagnetic; Hypersonic; Re-entry; RF; Plasma density reduction

N232-113 TITLE: On-Chip Optical Isolation for Integrated Photonics

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Nuclear;Quantum Science

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 the Announcement. 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 on-chip optical isolators at telecom wavelengths with a high isolation ratio, wide bandwidth, and low insertion loss.

DESCRIPTION: A complete integrated photonics toolset requires optical isolators and circulators. These components improve the routing of optical power on chip by blocking light from entering chosen ports [Refs 1,2]. Such a component is crucial to the performance of on-chip lasers. While in-line fiber-optic versions of these components are available, on-chip integration has been a major challenge.
Optical isolators and circulators rely on the breaking of Lorentz reciprocity. This can only be achieved using one of three approaches: nonlinear effects, magneto-optical effects, and spatio-temporal modulation [Ref 3].

In the past two years on-chip optical isolation in the C-band has been demonstrated for the first time in two separate approaches. First, advances in the deposition of cerium-doped yttrium iron garnet (Ce:YIG), a magneto-optical material, have allowed for the integration of thin-films onto the sidewalls of both silicon (Si) and silicon nitride (Si_3N_4) waveguides. Optical isolation in both transverse electric (TE) and transverse magnetic (TM) polarizations has been demonstrated in these platforms [Ref 5]. Second, two separate groups simultaneously demonstrated optical isolation with spatio-temporal modulation of piezoelectric modulators integrated on waveguides [Refs 3,4].

SSP calls for the development of an on-chip optical isolation capability at telecom wavelengths. Among other capabilities, this technology will enable integration of sensitive optical sources on photonic integrated circuits. Both spatio-temporal and magneto-optic solutions are encouraged to respond to this SBIR topic. As the technology is matured, performers will collaborate with SSP and government contractors to integrate the technology into relevant platforms. This collaboration will also seek to develop a technology transfer plan for commercial-scale photonics foundry fabrication.

PHASE I: Perform a design and fabrication analysis to assess the feasibility of the proposed technique or material development for on-chip isolation in the telecom wavelength range for use in integrated photonic devices. Include the expected isolation ratio (ideally > 30 dB) for the technique, expected die area required, insertion loss introduced (< 3 dB insertion loss preferred), and bandwidth. Identify risks and risk mitigation strategies. The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build prototype solutions in Phase II.

PHASE II: Fabricate and characterize five (5) prototypes that demonstrate the on-chip isolation capability. Variability of key metrics (isolation ratio, bandwidth) < 3% and optical insertion loss < 3 dB should be addressed with a mitigation plan to enable highly reliable performance as the system matures. The final report will include a discussion of potential near-term and long-term development efforts that would improve the technology's performance and ease of fabrication. It will also include an evaluation of the cost of fabrication and how that might be reduced in the future. The prototypes should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes and continual advancement of photonics capabilities, on-chip isolation technology should lead to dramatic improvements in the feasibility of achieving fully integrated photonic devices. Support the Navy in transitioning the technology to Navy use. The prototypes will be evaluated through optical characterization and testing with relevant adjacent devices. The end product technology could be leveraged to bring photonic imaging and sensing towards a more mature state with a lower size, weight, and power (SWaP) profile that could make it more attractive for optical communication and Light Detecting and Ranging (LIDAR) as well as in the biomedical, navigation, and vehicle autonomy markets.

REFERENCES:

1. Jalas, D., Petrov, A., Eich, M., Freude, W., Fan, S., Yu, Z., . . . Renner, H. (2013). What is - and what is not - an optical isolator. Nature Photonics, 7, 30 July 2013, pp. 579-582.
2. Mailis, S. (2021). On-chip non-magnetic optical isolator. Nature Photonics, 15, 794-795.
3. Sohn, D. B., Orsel, O. E., & Bahl, G. (2021, November). Electrically driven optical isolation through phonon-mediated photonic Autler-Townes Splitting. Nature Photonics, 822-827.
4. Tian, H., Liu, J., Siddharth, A., Wang, R., Blesin, T., He, J., . . . Bhave, S. A. (2021, November). Magnetic-free silicon nitride integrated optical isolator. Nature Photonics, 15, 828-835.
5. Yan, W., Yang, Y., Shuyuan, L., Zhang, Y., Xia, S., Kang, T., . . . Bi, L. (2020). Waveguide-integrated high-performance magneto-optical isolators and circulators on silicon nitride platforms. Optica, 1555-1561.

KEYWORDS: Photonic integrated circuits; optical; isolation; magneto-optics; spatio-temporal; telecom; photonics

VERSION 7

N232-114 TITLE: Miniaturized, High-accuracy, Radiation-hardened Rotary Angle Sensors

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Nuclear;Space Technology

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 the Announcement. 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 miniaturized rotary angle sensors (e.g. resolvers or encoders) of high accuracy that are radiation hardened and capable of performing in space flight in a contested environment.

DESCRIPTION: Requirements driving the reduction of size of the next-generation, guidance systems dictate the need for size-reduction of all componentry without a relaxation of performance requirements. These competing concerns drive the need for innovation in the componentry used throughout the system. One component technology that is of chief interest is rotary angle sensor technology; this component measures the angular position and rotational speed and direction of a rotating member. The technology must be precise, accurate, and stable over a long product lifetime, capable of surviving shock, vibration, and radiation characteristic of space flight through a contested environment, as well as small, lightweight, and low in power dissipation.

There are a variety of technology approaches that may prove viable for improving currently employed capabilities, some examples include capacitance encoders, optical encoders, inductive encoders, magnetic encoders, ultrasonic encoders, and rotary resolvers [Refs 1-5]. Many devices, across this range of technologies, are available commercially and have found widespread use in both industrial and defense applications on the ground as well as in space. Miniaturized rotary angle sensor technology sought by this SBIR holds the promise, provided that smaller variants can be developed that meet the both the unique accuracy and packaging and environmental requirements. The following is a list of these requirements:

Measurement range: 360 degrees
Measurement type: Absolute
Accuracy: < 20 arc second
Max Rotation Speed (at full accuracy) = 25 rpm
Interrogation rate = ~2.5 kHz
Power (Total)= < 2 watts
Power (Sense Head) = < 0.25 watts
Size (sense head): 1 inch diameter x 0.5 inches height (max)
Size (electronics): 0.5 in3 (max)
Operation Temperature Range: 5º C to 60º C
Storage Temperature Range: -40º C to 80º C
Operating Pressure: 0 to 75 psia
Humidity: 0 – 90% RH

Outline path toward meeting the performance requirements of a space launch environment for vibration and shock and a space radiation environment

PHASE I: Develop a design for a miniaturized rotary angle sensor based on the above requirements. Perform a study/analysis and show how the design should be able to fulfill the requirements. Define a test plan that will be used in Phase II to test the rotary encoder that exceeds the accuracy requirement listed.

The Phase I Option, if exercised, will include the initial design specifications and capabilities description to build a prototype solution in Phase II.

PHASE II: Based on the design and results from Phase I, build a small lot of three functional, highly accurate, miniaturized rotary angle sensors and control electronics. Characterize the performance of the batch of sensors according to the test plan outlined in Phase I. Delivery of not less than two (2) devices to the government for additional testing at the conclusion of Phase II.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes developed in Phase II, continue development leading to productization of highly accurate, miniaturized rotary angle sensors suitable for a variety of applications for the defense, aerospace, and commercial markets. Such sensors would be applicable for use in seeker heads, radar fire controls, stabilized platforms, robotic joint feedback, vehicle surface feedback and/or flight control surface feedback. Specific detailed design guidance will be provided during Phase III.

REFERENCES:

1. A. S. A. Kumar, B. George and S. C. Mukhopadhyay, "Technologies and Applications of Angle Sensors: A Review," in IEEE Sensors Journal, vol. 21, no. 6, pp. 7195-7206, 15 March15, 2021, doi: 10.1109/JSEN.2020.3045461
2. D. Zheng, S. Zhang, S. Wang, C. Hu and X. Zhao, "A Capacitive Rotary Encoder Based on Quadrature Modulation and Demodulation," in IEEE Transactions on Instrumentation and Measurement, vol. 64, no. 1, pp. 143-153, Jan. 2015, doi: 10.1109/TIM.2014.2328456
3. S. Das and B. Chakraborty, "Design and Realization of an Optical Rotary Sensor," in IEEE Sensors Journal, vol. 18, no. 7, pp. 2675-2681, 1 April1, 2018, doi: 10.1109/JSEN.2018.2794822
4. K. Miyashita, T. Takahashi and M. Yamanaka, "Features of a magnetic rotary encoder," in IEEE Transactions on Magnetics, vol. 23, no. 5, pp. 2182-2184, September 1987, doi: 10.1109/TMAG.1987.1065634
5. Z. Han, N. Wang, X. Zhu, Z. Li, Y. Cui and X. Jian, "A Miniature High-Frequency Rotary Ultrasonic Encoder for Internal Ultrasound Imaging," in IEEE Sensors Journal, vol. 21, no. 12, pp. 13137-13145, 15 June15, 2021, doi: 10.1109/JSEN.2021.3069433

KEYWORDS: rotary angle sensor; encoder; rotary resolver; capacitance encoder; optical encoder; inductive encoder; magnetic encoder; ultrasonic encoder

N232-115 TITLE: Radiation Tolerant Fiber Optic Communication

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Nuclear

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 the Announcement. 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: Investigate and demonstrate radiation tolerant transmission and receiving for single-phase fiber optics.

DESCRIPTION: The radiation effects and subsequent mitigation strategies for both traditional Integrated Circuits and Fiber Optics can be well understood and protected against an individual component level [Ref 1]. When scaling outward to a System level that integrates both, greater considerations must be taken to ensure general system survivability against radiation. The effects particularly can manifest themselves at the interfaces that combine both types of components in a potentially sensitive system.

There are several existing products and methods that may meet the requirements of a radiation tolerant transmission and receiving of optical signals [Ref 2], however, it is yet unknown if these types of devices used for civilian applications can fully meet strategic program needs. A comprehensive study and development effort is required to understand the feasibility of using fiber optics for communication within missile sub-systems. The cable system (i.e., transmitter, fiber, and receiver) will need to withstand radiation environments analogous to natural space, as well as man-made hostile conditions for a prompt high dose rate range of 1E11 to 1E13 rad(Si)/s, a Total Ionizing Dose range of 1E5 to 5E5 rad(Si), Neutron Displacement Damage maximum of 5E12 to 1E14 n/cm2, and X ray fluence range of 0.1 to 10 cal/cm2. Additional success criteria will be an improvement (i.e., reduction) of size, weight, and power (SWaP) as compared to traditional copper. In addition to a possible reduction in SWaP characteristics, the fiber cables themselves are inherently immune to EMI/EMP, whereas copper has to be shielded in order to reduce the effect to acceptable levels.

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 Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP 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 advanced phases of this contract.

PHASE I: Perform a feasibility study. All applicable environments will be considered and a plan developed detailing how each environment will be verified and, if necessary, mitigated. Feasibility will be evaluated in consideration of the aforementioned radiation environments as well as the increase/decrease in SWaP over common copper cables. Initial design specifications and capabilities description to build test articles will be developed or procured. The Phase I Option, if exercised, will entail prototype or procurement of the test articles, as well as further definition of the tests to be conducted in Phase II. These task suggestions are notional, and all qualifying and reasonable proposals will be considered.

PHASE II: Subject the test articles to the applicable environments. If certain tests are cost prohibitive, simulations may be developed and/or utilized to show compliance to requirements, however, a physical test is the preferred method of verification. Simulation methodology and data will be independently verified by the same standard as physical testing. Additional testing and/or analysis may be needed to verify reliability, robustness, etc. Commercialization strategy will be further refined.
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: Transition the technology to be used for the Trident D5 Life Extension II program. This technology will then be evaluated against the Defense Logistics Agency's Qualified Manufacturing Listing which will properly verify the different aspects of the technology, from its development and manufacturing to its field use, meeting strategic requirements. The aspects of the technology that don't meet standards may be adjusted and re-qualified. Once fully vetted and qualified, the technology may be purchased and integrated into the parts library of the program to be further tested and designed. At this stage it is expected that the company will have defined cost and manufacturing requirements and define the Intellectual Property needs, as well as meet with Naval financial experts to define a reasonable price for fielding the technology. In the commercial sector, this technology would apply towards producing high fidelity systems for space applications. These could include the advanced satellite systems as well as autonomous delivery systems that would require high speed, radiation tolerant system level data transfer.

REFERENCES:

1. Johnston, A. H. "Radiation Damage of Electronic and Optoelectronic Devices in Space." 4th International Workshop on Radiation Effects on Semiconductor Devices for Space Application, October 2000. https://nepp.nasa.gov/DocUploads/D41D389D-04D4-4710-BBCFF24F4529B3B3/Dmg_Space-00.pdf
2. Paschotta Rudiger. "Radiation-Resistant Fibers." RP-Photonics Encyclopedia. https://www.rp-photonics.com/radiation_resistant_fibers.html

KEYWORDS: Fiber Optics; Radiation Effects; Optics; Single-Phase Fiber; Reliability; Optoelectronics; Space

VERSION 7

N232-116 TITLE: Direct Etched Silicon Wafer Bonding for Micro-Electromechanical Systems (MEMS).

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics;Nuclear;Space Technology

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 the Announcement. 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 reliable direct silicon wafer bonding process with etched wafers.

DESCRIPTION: Direct silicon wafer bonding is the process of adhering two wafers together without any intermediate layers. Although this process is employed currently, it necessitates high standards in both surface geometry and roughness. Etched silicon wafers are often not considered for direct wafer bonding because of those standards. Adhesion layers, such as a eutectic metal layer, may overcome the stringent geometry standards required for direct bonding, but the mismatches of coefficient of thermal expansion (CTE) between the adhesion layer and the silicon device may lead to performance impacts for high stability sensors, such as long-term creep. Examples of existing research for direct wafer bonding can be found in the referenced articles [Refs 1-4].

MEMS sensors are more frequently being considered as alternatives to conventionally machined sensors in order to meet performance requirements in a low size, weight, and power (SWaP) package. This process is likely to bring value to multiple industries as the need for stability and reliability become more important.

PHASE I: Design a direct wafer bonding process with the desired goals of 1) forming a complete bond with at least one etched silicon wafer (bond areas no less than 100 µm x 100 µm, etch depth no greater than 200 µm); 2) demonstrating a hermetic seal with both an inert gas (such as dry nitrogen) or vacuum after dicing into separate devices; 3) ensuring reliability of the bond through thermal environments (between -55ºC to 85ºC) and mechanical environments such as vibration, shock, bond strength, and constant acceleration (see MIL-STD-883-2 for reference). The Phase I study shall assess all aspects of the bonding process and justify the feasibility and practicality of the designed approach. The Phase I Option, if exercised, will include the initial design specifications and capabilities to build a prototype solution in Phase II.

PHASE II: Based on the Phase I design and execution plan, fabricate and characterize a small lot (up to Qty: 5 wafers) of silicon articles. This characterization may include hermetic leak checking, bond strength tests, and wafer uniformity for sample MEMS devices. Wafers will need to be etched, bonded, and diced to resemble a typical MEMS device process. The prototypes, test samples, and characterization results should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: Based on the prototypes developed in Phase II, continuing development must lead to productization of the direct wafer bonding process. Qualify this product by inserting and demonstrating the bonding process into a known microfabrication process for a MEMS design. If required, subject the devices incorporating the wafer bonding process to several common test environments, including radiation and vibration environments.

VERSION 7

While this technology is aimed at multiple national interest applications, wafer bonding is used more broadly in the MEMS industry. A direct bonding process for etched wafers is likely to bring value to existing commercial applications such as space and autonomous vehicle navigation to improve both the reliability and performance of high-end MEMS sensors.

REFERENCES:

1. Gui, C.; Elwenspoek, M.; Tas, N. and Gardeniers, J.G.E. “The effect of surface roughness on direct wafer bonding.” Journal of Applied Physics, Vol. 85, No. 10, May 1999, pp. 7448-7454. https://aip.scitation.org/doi/abs/10.1063/1.369377
2. Moriceau, H.; Rieutord, F.; Fournel, F.; Le Tiec, Y.; Di Cioccio, L.; Morales, C.; Charvet, A.M. and Deguet, C. “Overview of recent direct wafer bonding advances and applications.” Advances in Natural Sciences: Nanoscience and Nanotechnology, Vol. 1, No. 4, December 2010. https://iopscience.iop.org/article/10.1088/2043-6262/1/4/043004/meta
3. Turner, K.T. and Spearing, S.M. “Modeling of direct wafer bonding: Effect of wafer bow and etch patterns.” Journal of Applied Physics, Vol. 92, No. 12, December 2002, pp. 7658-7666. https://aip.scitation.org/doi/abs/10.1063/1.1521792
4. Mehra, A.; Zhang, X.; Ayon, A.A.; Waitz, I.A.; Schmidt, M.A. and Spadaccini, C.M. "A six-wafer combustion system for a silicon micro gas turbine engine." Journal of Microelectromechanical Systems, Vol. 9, No. 4, December 2000, pp. 517-527. https://ieeexplore.ieee.org/abstract/document/896774

KEYWORDS: Direct wafer bonding; MEMS; micro-electromechanical; systems; microfabrication; wafers

VERSION 4

DEPARTMENT OF THE NAVY (DON)
23.2 Small Business Innovation Research (SBIR)
Direct to Phase II (DP2) Announcement and Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to Direct to Phase II (DP2) SBIR topics only:**
  - **N232-D07 through N232-D09**
- **The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposing small business concerns are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.**
- A DP2 Phase I Feasibility proposal template (for Volume 2), unique to DP2 topics, and a Supporting Documents template (Volume 5) are available at https://www.navysbir.com/links_forms.htm.
- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- This BAA is issued under regulations set forth in Federal Acquisition Regulation (FAR) 35.016 and awards will be made under "other competitive procedures". The policies and procedures of FAR Subpart 15.3 shall not apply to this BAA, except as specifically referenced in it. All procedures are at the sole discretion of the Government as set forth in this BAA. Submission of a proposal in response to this BAA constitutes the express acknowledgement to that effect by the proposing small business concern.

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information on DON's mission can be found on the DON website at www.navy.mil.

The Department of Defense (DoD), including the Department of the Navy (DON), may issue an SBIR award to a small business concern under Phase II , without regard to whether the small business concern received a Phase I award for such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the small business concern has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DON issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those proposing small business concerns that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

Digital Engineering. DON desires the ability to design, integrate, and test naval products by using authoritative sources of system data, which enables the creation of virtual or digital models for learning and experimentation, to fully integrate and test actual systems or components of systems across disciplines to support lifecycle activities from concept through disposal. To achieve this, digital engineering innovations will be sought in topics with titles leading with DIGITAL ENGINEERING.

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	**When**	**Contact Information**
Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N232-D07	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N232-D08 to N232-D09	Mr. Jason Schroepfer	Naval Sea Systems Command (NAVSEA)	NSSC_SBIR.fct@navy.mil

Each DON SBIR DP2 topic requires documentation to determine that Phase I feasibility, described in the Phase I section of the topic, has been met.

The DON SBIR DP2 is a two-step process:

STEP ONE: Prepare and Submit a Phase I Feasibility Proposal (instructions and link to template provided below). The purpose of the Phase I Feasibility Proposal is for the proposing small business concern to provide documentation to substantiate that both Phase I feasibility and the scientific and technical merit described in the topic have been met. The Phase I Feasibility Proposal must: demonstrate that the proposing small business concern performed Phase I-type research and development (R&D) and provide a concise summary of Phase II objectives, work plan, related research, key personnel, transition/commercialization plan, and estimated costs. Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. The government will evaluate Phase I Feasibility Proposals and select small business concerns to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The small business concern must submit a Phase I Feasibility Proposal to be considered for selection to submit a Full DP2 Proposal.

STEP TWO: If selected, the cognizant SYSCOM Program Office will contact the small business concern directly to provide instructions on how to submit a Full DP2 Proposal.

DON SBIR reserves the right to make no awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposing small business concerns must read the topic requirements carefully. The Government is not responsible for expenditures by the proposing small business concern prior to award of a contract. For 23.2 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following section details requirements for submitting a compliant DON SBIR DP2 Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposing small business concerns are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); follow proposal submission instructions in the DoD SBIR/STTR Program BAA on the DSIP at https://www.dodsbirsttr.mil/submissions. Proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that proposing small business concerns register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified electronically in DSIP by the Corporate Official prior to BAA Close will NOT be considered submitted and will not be evaluated by DON. Please refer to the DoD SBIR/STTR Program BAA for further information.

Eligibility. Each proposing small business concern must:

- Have demonstrated feasibility of Phase I-type R&D work
- Have submitted a Phase I Feasibility Proposal for evaluation
- Meet Offeror Eligibility and Performance Requirements as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA
- Comply with primary employment requirements of the principal investigator (PI) during the Phase II award including, employment with the small business concern at the time of award

and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the small business concern
  - Register in the System for Award Management (SAM) as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA. To register, visit https://sam.gov/

Proposal Volumes. The following six volumes are required.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
    - Single column format, single-spaced typed lines
    - Standard 8 ½" x 11" paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point

  - Additional information:
    - It is highly recommended that proposing small business concerns use the DP2 Phase I Feasibility proposal template at https://navysbir.com/links_forms.htm to meet DP2 Technical Volume (Volume 2) requirements.
    - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.

- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at https://www.dodsbirsttr.mil/submissions/), however, proposing small business concerns DO NOT need to download and complete the separate cost volume template when submitting the DON SBIR Phase I Feasibility Proposal. Proposing small business concerns are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Snapshot of Proposed Phase II Effort portion of the Technical Volume (Volume 2). Please refer to Table 3 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

Order of Magnitude Cost Estimate Table			
Line Item – Details	**Estimated Base Amount**	**Estimated Option Amount**	**Total Estimated Amount Base + Option**
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			

Fee/Profit			
TABA (NTE $25K, included in total amount)			
Total Estimated Costs			

TABLE 3: COST & PERIOD OF PERFORMANCE

Topic Number	Base		Option		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N232-D07	$1,000,000	24 mos.	$300,000	12 mos.	$1,300,000
N232-D08 to N232-D09	$600,000	12 mos.	$1,200,000*	24 mos.*	$1,800,000*

* Step Two: for the Full Phase II submission, if selected, topics N232-D08 and N232-D09 will require the Phase II Option 1 and Phase II Option 2 to be detailed separately:

- Phase II Option 1: Cost $600,000, Period of Performance 12 months
- Phase II Option 2: Cost $600,000, Period of Performance 12 months

- Additional information:
  For Phase II a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator. **NOTE:** G&A, if proposed, will only be attributed to the proposing small business concern.
  - Provide sufficient detail for subcontractor, material, and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel.
  - Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.
  - The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3.

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.

  All proposing small business concerns must review and submit the following items, as applicable:
  - **Telecommunications Equipment Certification.** Required for all proposing small business concerns. The DoD must comply with Section 889(a)(1)(B) of the FY2019

National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As such, all proposing small business concerns must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.

- **Disclosures of Foreign Affiliations or Relationships to Foreign Countries.** Each proposing small business concern is required to complete Attachment 2 of this BAA, "Disclosures of Foreign Affiliations or Relationships to Foreign Countries" and upload the form to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
  - Program Description
  - Proposal Fundamentals
  - Phase I Proposal
  - Attachment 2
- **Certification Regarding Disclosure of Funding Sources.** Each proposing small business concern must comply with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. The disclosure and certification must be made by completing Attachment 4, Disclosure of Funding Sources, and uploading to Volume 5, Supporting Documents. Please refer to the following sections of the DoD SBIR/STTR Program BAA for details:
  - Phase I Proposal
  - Attachment 4
- **Majority Ownership in Part.** Proposing small business concerns which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA. Complete certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

- Additional information:
  - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
    - Additional Cost Information to support the Cost Volume (Volume 3)
    - SBIR/STTR Funding Agreement Certification
    - Data Rights Assertion
    - Allocation of Rights between Prime and Subcontractor
    - Disclosure of Information (DFARS 252.204-7000)
    - Prior, Current, or Pending Support of Similar Proposals or Awards
    - Foreign Citizens

- Do not include documents or information to substantiate the Technical Volume (Volume 2) (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.
- A font size smaller than 10-point is allowable for documents in Volume 5; however, proposing small business concerns are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

DP2 EVALUATION AND SELECTION

The following section details how the DON SBIR/STTR Programs will evaluate Phase I Feasibility proposals.

Proposals meeting DSIP submission requirements will be forwarded to the DON SBIR/STTR Programs. Prior to evaluation, all proposals will undergo a compliance review to verify compliance with DoD and DON SBIR/STTR proposal eligibility requirements. Proposals not meeting submission requirements will be REJECTED and not evaluated.

- **Proposal Cover Sheet (Volume 1).** The Proposal Cover Sheet (Volume 1) will undergo a compliance review to verify the proposing small business concern has met eligibility requirements and followed the instructions for Proposal Cover Sheet as specified in the DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I Feasibility proposals using the evaluation criteria specified in the Phase I Proposal Evaluation Criteria section of the DoD SBIR/STTR Program BAA, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

  The Technical Volume (Volume 2) will undergo a compliance review (prior to evaluation) to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
  - Single column format, single-spaced typed lines
  - Standard 8 ½" x 11" paper
  - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
  - No font size smaller than 10-point, except as permitted in the instructions above.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:

— Must not exceed values for the Base and Option (refer to Table 3).
— Must meet minimum percentage of work; a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work requirement must be met in the Base costs as well as in the Option costs.

- **Company Commercialization Report (Volume 4).** The CCR (Volume 4) will not be evaluated by the Navy nor will it be considered in the Navy's award decision. However, all proposing small business concerns must refer to the DoD SBIR/STTR Program BAA to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposing small business concern has included items in accordance with the DP2 SUBMISSION INSTRUCTIONS section above.

- **Fraud, Waste, and Abuse Training Certificate (Volume 6).** Not evaluated.

ADDITIONAL SUBMISSION CONSIDERATIONS

This section details additional items for proposing small business concerns to consider during proposal preparation and submission process.

Due Diligence Program to Assess Security Risks. The SBIR and STTR Extension Act of 2022 (Pub. L. 117-183) requires the Department of Defense, in coordination with the Small Business Administration, to establish and implement a due diligence program to assess security risks presented by small business concerns seeking a Federally funded award. Please review the Program Description section of the DoD SBIR/STTR Program BAA for details on how DoD will assess security risks presented by small business concerns.

Discretionary Technical and Business Assistance (TABA). The SBIR and STTR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Proposing small business concerns may request, in their Cost Volume (Volume 3), to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,800,000 or lower limit specified by the SYSCOM). The amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project. A TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

Request for TABA funding will be reviewed by the DON SBIR/STTR Program Office.

If the TABA request does not include the following items the TABA request will be denied.

- TABA provider(s) (firm name)

- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included in the proposal as follows:

- Phase II:
- — DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
- — Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as "TABA" in the section titled Additional Cost Information when using the DON Supporting Documents template.

Proposed values for TABA must NOT exceed:

- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

If a proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual DON STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the proposing small business concern shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DON Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DON Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the government Contracting Officer, noted in the contract.

Majority Ownership in Part. Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, **are eligible** to submit proposals in response to DON topics advertised within this BAA.

For proposing small business concerns that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

a. Prior to submitting a proposal, proposing small business concerns must register with the SBA Company Registry Database.
b. The proposing small business concern within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents (Volume 5).
c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

System for Award Management (SAM). It is strongly encouraged that proposing small business concerns register in SAM, https:// sam.gov, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a small business concern is required to implement NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items please visit https://www.sprs.csd.disa.mil/webtrain.htm.

Human Subjects, Animal Testing, and Recombinant DNA. If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

Notifications. Email notifications for proposal receipt (approximately one week after the Phase I BAA Close) and selection are sent based on the information received on the proposal Cover Sheet (Volume 1). Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Debriefs. Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the proposal of the proposing small business concerns within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests. Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil. A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

Awards. Due to limited funding, the DON reserves the right to limit the number of awards under any topic. Any notification received from the DON that indicates the proposal has been selected does not ultimately guarantee an award will be made. This notification indicates that the proposal has been selected in accordance with the evaluation criteria and has been sent to the Contracting Officer to conduct cost analysis, confirm eligibility of the proposing small business concern, and to take other relevant steps necessary prior to making an award.

Contract Types. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Proposal Fundamentals, for Phase II awards the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Contract Deliverables. Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

Transfer Between SBIR and STTR Programs. Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa.

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description. Consequently, DON will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

VERSION 4

Navy SBIR 23.2 Direct to Phase II Topic Index

VERSION 4

N232-D07 TITLE: DIRECT TO PHASE II - Augmented Reality for Live Flight Training

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Human-Machine Interfaces;Sustainment;Trusted AI and Autonomy

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 the Announcement. 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 Augmented Reality (AR) to provide a potential solution for reducing the need for costly, live, multi-ship scenarios by integrating visible constructive entities via AR presentations during live flight training events.

DESCRIPTION: Technology has greatly outpaced updates to aviation training, and though many aerospace corporations are embracing different forms of Extended Reality (XR) for use in aircrew and maintenance training [Ref 1], most of the Navy’s current training syllabi have remained unchanged for decades. With fleet aircraft also becoming more complex, the basic piloting skills being taught at the undergraduate level are not preparing students adequately for the more advanced critical thinking and mission planning required for Fleet Replacement Squadron (FRS) training. With XR technologies improving exponentially, while also becoming cheaper, the traditional focus on the accumulation of flight hours to develop basic airmanship skills is no longer the optimal method to train effectively and efficiently, both in terms of quality and cost. Shifting away from a time-based to a competency-based approach to training with the incorporation of XR technology could provide a higher-level of training that would meet FRS entry-level requirements at a lower cost.

To make this shift, the Navy started Naval Aviation Training Next (NATN), a broad initiative focused on producing higher quality aviators in a more efficient manner. A primary catalyst behind NATN is the use of XR technologies. To date, the effort has been focused on virtual reality (VR) to provide students an immersive, lower cost platform capable of practicing procedures before doing them in the aircraft, better preparing them for flight events, which in turn allows flight events to focus on higher complexity or more difficult scenarios. This crawl-walk-run approach with VR has been demonstrated to successfully train flight procedures in a lower cost platform before demonstrating the same procedures in an aircraft [Refs 2, 3], where resources are scarce, and costs are high. Under this crawl-walk-run framework of training [Ref 4], the VR training is allowing students to shift the historical ‘crawling’ during initial flights to ‘walk’ or ‘run’ training in the aircraft, with the ‘crawling’ accomplished in VR. With the ability to execute any syllabus maneuvers in a VR device, NATN training has rapidly shown to be more efficient while also building higher quality pilots [Ref 5]. A natural extension of the VR training is to incorporate AR into actual aircraft training, as flight time gained in actual aircraft is invaluable and greatly reinforces skills learned during ground training.

AR has the potential to provide more efficient and effective training for undergraduate pilots to increase their capabilities during flight events while reducing resource requirements. An important factor for AR is its ability to ‘overlay information at the point of need’ [Ref 6] making it a potentially very powerful training tool for nearly any flight training scenario by either inserting visible constructive entities, or guiding student attention to specific areas. For example, undergraduate jet training incorporates significant formation training to develop skills that are foundational for fleet assignments and missions.

AR could supplement this training by utilizing a visible, constructive, formation partner in early stages of training instead of relying on another live aircraft, improving safety by avoiding possibilities of mid-air collisions while lowering overhead costs associated with utilizing multiple aircraft for training, ultimately reducing overall training time and cost by re-allocating live flight resources to other student naval aviators (SNAs) and events. Additionally, AR can improve training quality by allowing more practice opportunities for students to develop these important skillsets and fit into NATN's methods for immersive 'crawl-walk-run' training by facilitating the 'walk' to 'run' in live flight: the student is able to practice the basics of formation flying to better prepare for events with actual partner aircraft. Other logical areas in which AR could facilitate training include more advanced tactical formation flying, basic fighter tactics, aerial refueling, weapons deployment visuals, air-to-air engagement, air-to-surface missions, and other mission sets involving interaction with outside entities increasing the training capabilities and ability to introduce more complicated scenarios earlier in training.

In this Direct to Phase II SBIR topic, the Navy seeks an AR solution that would provide high-fidelity, behaviorally accurate, and visible constructive entities for live flights within the training pipeline successfully integrated into a military aircraft. Primary focus will be on demonstrating capability to support training scenarios with constructive entities in a military aircraft by successfully integrating an AR system into a Navy training aircraft and aviator gear for safe use in flight. At this stage, the AR system it is not expected (but is encouraged if meeting milestones) to be flown in military aircraft, but shall be demonstrated as capable for in-flight use by other means to provide evidence of reliability and functionality in the dynamic flight environment. Careful consideration should be given to scenario development and behaviorally accurate models of any constructive entities developed. Other items to consider should be system performance measures and assessment, integration into Navy data and grading systems, and methods for debrief utilizing scenario data from constructive entities. It is anticipated this technology would expand the NATN competency-based instructional model into live aircraft flight training, lowering training overhead while increasing training efficiency and output, by supplementing various training scenarios requiring multiple aircraft.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. It must have developed a concept for a workable prototype or design to address at a minimum the basic requirements of the stated objective. The below actions would be required in order to successfully satisfy the requirements of Phase I:
Designed a proof-of-concept technology that demonstrates high-fidelity virtual aircraft within an AR environment with high-quality real-world visuals.

Determined the technical feasibility of integrating virtual lead aircraft visuals for an aviator in full aviator gear in an actual aircraft cockpit.

Determined the feasibility of the technology meeting Risk Management Framework guidelines [Ref 7] to support cybersecurity compliance outlined in Defense Federal Acquisition Regulation Supplement (DFARS) and published in National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 "Protecting Unclassified Information in Non-federal Information Systems and Organizations" [Ref 8].

Determined the technical feasibility to incorporate performance assessment capabilities for After Action Review (AAR).

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. 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). Read and follow all of the DON SBIR 23.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop a prototype of the AR flight training system integrated into a Navy military training aircraft (e.g., T-45) capable of presenting in an aviators visual field accurate and dynamic digital entities. By integration, the AR system should be fully functional and usable by an aviator without impeding any operation of the aircraft by the aviator or limiting access or function of aircrew gear. Major areas to consider include, but are not limited to: power supply; required computer processing; size, weight, and location of components; and interaction with aircrew gear. Consider and adhere to the Risk Management Framework guidelines during the development to support information assurance compliance [Ref 7]. Demonstrate the prototype integrated into the military aircraft in a relevant but safe environment (e.g., ground demonstration).

PHASE III DUAL USE APPLICATIONS: Develop hardened system architecture and complete the Risk Management Framework process to gain cybersecurity accreditation for system deployment. Demonstrate the ability to integrate transition-specific content for initial training capability transition for use during live flight in a Navy military training aircraft. Demonstrate the ability to incorporate product into a learning management system (LMS) for sustainment. Undergo safety of flight evaluations for approval for use during flight.

Development of AR technology for use during flight will present new training capabilities for commercial industry, providing civilian training programs with safer and more immersive training methodologies for scenarios like potential bird strikes, high traffic patterns, landmark identifications, and more. Additionally, once demonstrated as beneficial in an unclassified training context, the AR capability can be expanded to multiple military training platforms to aid not only training but mission rehearsal and planning across all aircraft, significantly reducing flight hour costs and time to train.

REFERENCES:

1. Bellamy III, W. (2017, August 24). 9 companies using augmented and virtual reality in aviation. Aviation Today. https://www.aviationtoday.com/2017/08/24/9-companies-using-augmented-virtual-reality-aviation/
2. Severe-Valsaint, G., Mishler, A., Natali, M., Astwood, R., Seech, T., & McCoy-Fisher, C. (2022). Training effectiveness evaluation of an adaptive virtual instructor for naval aviation training (NAWCTSD Public Release 22-ORLO44). Defense Technical Information Center, 2022. https://apps.dtic.mil/sti/citations/AD1170195
3. McCoy-Fisher, C., Mishler, A., Bush, D., Severe-Valsaint, G., Natali, M., & Riner, B. (2019, September 30). Student naval aviation extended reality device capability evaluation (Report No. NAWCTSD-TR-2019-001). Defense Technical Information Center. https://apps.dtic.mil/sti/citations/AD1103227
4. Kinney, M. (2008, July 17). What the Army taught me about teaching. Inside Higher Ed. https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/GENPRESS/I080717K.pdf
5. Mishler, A., Severe-Valsaint, G., Natali, M., Seech, T., McCoy-Fisher, C., Cooper, T., & Astwood, R. (2022, January 20). Project Avenger training effectiveness evaluation (Report No. NAWCTSD Public Release 22-ORL006). Defense Technical Information Center, 2022, https://apps.dtic.mil/sti/citations/AD1162306.

6. Goel, A. (2018, March 19). Augmented reality in aviation: Changing the face of the sector through training and simulated experience. eLearning Industry. https://elearningindustry.com/augmented-reality-in-aviation-changing-face-sector-training-simulated-experience
7. Department of Defense Education Activity. (2019, October 29). DoDEA administrative instruction 8510.01: Risk management framework for DoDEA information technology. Department of Defense. https://www.dodea.edu/Offices/PolicyAndLegislation/upload/DoDEA-AI-8510-01-Risk-Management-Framework.pdf
8. Ross, R., Pillitteri, V., Dempsey, K., Riddle, M., & Guissanie, G. (2020). Protecting controlled unclassified information in nonfederal systems and organizations. National Institute of Standards and Technology Special Publication 800-171 Revision 2. U.S. Department of Commerce. https://doi.org/10.6028/NIST.SP.800-171r2

KEYWORDS: augmented reality; AR; extended reality; XR; aviation training; training systems; aircraft integration; live-virtual-constructive

N232-D08 TITLE: DIRECT TO PHASE II – Direct Delivery of Commercial Earth Observation Data to DoD Using Proliferated Low Earth Orbit Transport Layer

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Trusted AI and Autonomy

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 the Announcement. 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 an Intersatellite Link (ISL) capability to deliver secure data to the Navy via Government communication transport satellites to reduce latency of data delivery to warfighters.

DESCRIPTION: The warfighters need data in near real time to perform mission planning in areas of naval conflict. In order for this to be achieved, ISLs can be used to reduce the latency of data delivery to the warfighter, reduce the complexity of direct downlink (DDL) coordination, and increase access to areas of interest (AOIs) by removing the constraints for ground stations being required to be located in the same geographic area as the observation point. Traditional satellite data delivery exploits radio frequency (RF) communications between satellites and ground stations. In order for satellites to communicate with each other, a ground station must route the data received from one satellite's downlink to another satellite's uplink. Current data delivery methods entail a significant latency of 30 to 90 minutes. This is because satellites must wait until they pass over a fixed ground station to downlink the data. The Space Development Agency (SDA) is currently reaching out to industry for help increasing capabilities amongst Proliferated Low Earth Orbit (pLEO) satellites by using ISLs. ISLs create an orbital mesh network between hundreds of satellites. Using ISLs allows satellites to directly communicate with each other rather than having to downlink to a ground station then uplink to another satellite. The government seeks a solution to accept direct delivery of commercial earth observation to a government owned pLEO system with an initial focus on the emerging SDA tranche 1 transport layer. Currently nothing exists to provide this solution.

SDA has developed the Transport Layer, an experimental military LEO satellite constellation designed to transfer data more rapidly, to get the tactical information needed to the warfighter. This constellation is planned to have 300 to 500+ LEO satellites. Typical delivery methods of commercial observation data from commercial companies to DoD customers comprises downlinking sensor data to a fixed commercial ground station and delivering products to Government data repositories 30 minutes to 12 hours after observation. With the advent of DoD pLEO constellations there is an opportunity for inter-orbit delivery of commercial earth observation data to DoD pLEO transportation layers. This will require link acquisition between the commercial company and the transportation layer, routing of the data, and negotiation of bandwidth and link resources.

The Transport Layer is designed to connect DOD sensors and combat systems by utilizing earth observation satellites and ground stations. It is envisioned with a full constellation to have at least two satellites in view of 95% of locations on earth at any given time, while 99% will have at least one satellite in view (i.e., constant coverage). SDA is expected to launch Tranche 0 in 2023, which will consist of 20 satellites and have a limited networked capability. Tranche 1 is expected to launch in 2024 and will have 126 satellites. Tranche 1 will leverage the capabilities demonstrated in Tranche 0 while also integrating capabilities using Link-16 and Integrated Broadcast System (IBS). Leveraging these capabilities in conjunction with the ISLs to interoperate with commercial sensing systems will enhance warfighter capabilities by providing near real-time critical target information and reducing latency and path loss of downlinked data within 60 seconds of observation and = 5 minutes for fully rendered images. By leveraging these capabilities the tasking, collection, processing, exploitation, and dissemination (TCPED) kill-chain gains impact from direct uplink from MTC - A/X, and is able to evaluate end-to-end impacts to existing commercial architecture. The Transport layer is expected be able to reach an altitude between 900-1100 km as well achieve a crosslink in the SDA Optical Communications Terminal which will be provided during contract award.

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 Counterintelligence and Security Agency (DCSA). The selected contractor 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 DCSA and NAVSEA 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: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Develop an ISLs concept for a low latency secure data delivery capability between earth observation satellites and the Government.
- Demonstrate key attributes of the concept feasibility to meet the Navy needs as stated in the Description. Key attributes include, but are not limited to, tasking, collection, processing, exploitation, and dissemination (TCPED) performance gains by adding the ISL capability to the space layer, impact from Direct Uplink from MTC-A/X, and evaluating end-to-end impacts to existing commercial architecture.
- Feasibility must be demonstrated through modeling and analysis.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. 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). Read and follow all of the DON SBIR 23.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop and deliver an ISL prototype for a low latency secure data delivery capability between earth observation satellites and the Government. The prototype will be evaluated to determine the capability meets performance goals defined in the Phase II development plan and the Navy requirements.

Additionally, develop a Phase III development plan with performance goals and key technical milestones that scales the ISL solution across the earth observation satellite constellation.
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: Clearly identify and describe the expected transition of the product/process/service within the government as a result of the Phase II in which the small business will participate under a Phase III.

Support the Navy in transitioning the technology for use in MTC-A/X. Develop the ISL for evaluation to determine its effectiveness in providing faster more secure data delivery to the warfighter. Support the Navy for testing and validation to certify and qualify the capability for Navy use.
Integrate ISL solution across all future commercial earth observation satellites that are replenishing the constellation pending results from the prototype integration events.
As technology continues to be improved over time, cloud-based applications are increasing services. This requires a constant reliable connection in order to receive and transmit data wherever operational. This is especially important with mobile and remote operations, similar to ships at sea. 'Always on' data delivery is also often used in the oil and gas industry for a "digital oilfield" where they need to consistently and rapidly move large quantities of data around the world.

REFERENCES:
1. Strout, Nathan. "Space Development Agency Wants to Update Standard for its Orbital Mesh Network" C4ISRNet, 21-April 2021. https://www.c4isrnet.com/show-reporter/c4isrnet-conference/2021/04/21/space-development-agency-wants-to-update-the-standard-for-its-orbital-mesh-network/
2. Erwin, Sandra. "Space Development Agency Revises Transport Layer Procurement, With Fewer Satellites Per Launch" Space News, 27-September 2021. https://spacenews.com/space-development-agency-revises-transport-layer-procurement-with-fewer-satellites-per-launch/

KEYWORDS: Satellite Downlink; Transport Layer; Proliferated Low Earth Orbit; Space Development Agency; Orbital Mesh Network; Intersatellite Links; Latency.

VERSION 4

N232-D09 TITLE: DIRECT TO PHASE II – Observation Cone Enhancements for Low-earth Orbit Satellites

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology;Trusted AI and Autonomy

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 the Announcement. 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 capability that improves coverage gaps of Areas of Interest (AOIs) of existing and future naval conflict.

DESCRIPTION: Current Field of Regard (FOR) limits the taskability for commercial assets to ±30° due to the spatial resolution on the extreme slants. The Navy seeks software development incorporating georectification techniques for commercial Low-earth Orbit (LEO) satellites that allow improved taskability of these sensors to support Naval missions, providing more tactically relevant information to the warfighter. This capability does not currently exist.

High revisit rates of remote sensing imagery are of high importance to the Navy. One of the factors that determine this revisit rate is the extent off-nadir that imagery satellites can make collections. Existing remote sensing imagery collects for commercial LEO satellites are limited to the satellite observation cone available due to the spatial resolution at boundaries (i.e., the off-nadir limitations). Though there is variation among commercial systems, the Navy observes typical off-nadir extents for commercial LEO satellites at approximately ±30°. By increasing the revisit rates to multiple revisits per day information characterizing rapid change or unusual activity can be captured. This information allows the warfighter to make critical decisions and resource allocation. Large off-nadir collections (> ±30°) offer the possibility to increase these revisit rates at the risk of lower fidelity images. The capability must demonstrate trading performance on the National Image Interpretability Rating Scale (NIIRS for Electro-Optical, also Radar NIIRS or RNIIRS for Synthetic Aperture Radar) for increased area coverage improves tactical relevance while still achieving data fidelity requirements for maritime applications. The solution will require a demonstration of increased FOR in a test environment where ground software is able to georectify beyond the baseline observation cone. Desired performance is = 1 km georectification for extended range over open ocean and = 5 m ground resolution.

The Navy recognizes that space vehicle and payload design constraints as well as data processing algorithms may impede off-nadir experimentation. In addition to spatial resolution on Earth's surface, one key AOI is geolocation accuracy. Geolocation refers to the ability to accurately locate an image on a coordinate system. It consists of 3 major parts: (i) position, velocity, and pointing data from the satellite to coarsely locate the image; (ii) georectification to take the image and match it to landmarks and identifiable features; and (iii) orthorectification to remove sensor, terrain, atmospheric, and terrain related geometric distortions. By enhancing satellite data, orthorectification, and georectification algorithms, the observation cone can be increased allowing for a wider FOR with validated accuracy.

Software development to increase the extent of off-nadir collections and positional accuracy of the AOI can increase the taskability and revisit rate of commercial assets to support DoD missions. LEO satellites take between 90 minutes to 2 hours to complete one orbit and are only communicating with a ground station for 5 - 10 minutes at a time. An increased FOR delivers more tactically relevant data to the warfighter during ground station communication. This software should be able to georectify the data over open ocean when observing the earth at extreme slant angles.

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 Counterintelligence and Security Agency (DCSA). The selected contractor 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 DCSA and NAVSEA 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: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Develop a concept to significantly increase the off-nadir collection capability of commercial LEO high-resolution imaging satellites over open ocean within existing baseline operating limits. Submitting small business concerns must provide current off-nadir collection capabilities as the baseline.
- Demonstrate the key attributes of the concept feasibility to meet the Navy needs. Key attributes include but are not limited to the capability to collect imagery at angles significantly greater than ±30° off-nadir, successful georectify and orthorectify the image, and determine its geolocation accuracy.
- Feasibility must be demonstrated through modeling and analysis.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic:

Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. 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). Read and follow all of the DON SBIR 23.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop and deliver a prototype of the software and demonstrate an increased observation cone for commercial LEO satellites from concept development in Phase I. The prototype will be evaluated in operationally relevant exercises to determine the capability in meeting performance goals defined in the description and the Navy requirements.

PHASE III DUAL USE APPLICATIONS: Support the Navy in transitioning the technology for use in wartime environment. Develop software for commercial LEO satellites for evaluation to determine its

effectiveness in increasing taskability options of these satellites. Support the Navy for testing and validation of software in MTC-A/X to certify and qualify the capability for Navy use.
Improved revisit rates using off-nadir imagery collection with accurate geolocation would benefit multiple commercial and civil applications such as providing relief during natural disasters and locating assets in a mishap at sea.

REFERENCES:

1. G. M. Kumari, T. Radhika, R. V. G. Anjaneyulu, C. Venkateswara Rao and V. M. Bothale, "Off-nadir viewing effects in High resolution Data," 2019 IEEE Recent Advances in Geoscience and Remote Sensing : Technologies, Standards and Applications (TENGARSS), 2019, pp. 123-127, doi: 10.1109/TENGARSS48957.2019.8976056. https://ieeexplore.ieee.org/document/8976056
2. Weir, Nick. “Challenges with SpaceNet 4 off-nadir satellite imagery: Look angle and target azimuth angle”, Medium, 9-Nov 2018. https://medium.com/the-downlinq/challenges-with-spacenet-4-off-nadir-satellite-imagery-look-angle-and-target-azimuth-angle-2402bc4c3cf6
3. News Desk, “BlackSky achieves world’s highest revisit, time-diverse dawn-to-dusk satellite constellation with three successful launches in three weeks”, Geospatial World, 14-Dec 2021. https://www.geospatialworld.net/news/blacksky-achieves-worlds-highest-revisit-time-diverse-dawn-to-dusk-satellite-constellation-with-three-successful-launches-in-three-weeks/

KEYWORDS: Satellite Observation Cone; Field of Regard; observation at extreme slant angles; off-Nadir; Georectify; Low-Earth Orbit; National Image Interpretability Rating Scale.

Defense Health Agency (DHA)
2023.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Health Agency (DHA) SBIR/STTR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

Proposers responding to a topic in this Broad Agency Announcement (BAA) must follow all general instructions provided in the Department of Defense (DoD) Program BAA. DHA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

The DHA Program participates in up to three DoD SBIR BAAs each year. Proposals not conforming to the terms of this BAA will not be considered. Only Government personnel will evaluate proposal submissions.

Specific questions pertaining to the administration of the DHA SBIR/STTR Program and these proposal preparation instructions shall be directed to:
DHA SBIR Program Management Office (PMO)
Email: usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil
Phone - (301) 619-5146

For technical questions about a topic during the pre-release period, contact the Topic Author(s) listed for each topic in the BAA. To obtain answers to technical questions during the formal BAA period, visit the Topic Q&A: https://www.dodsbirsttr.mil/submissions/login.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed **20 pages** and must follow the formatting requirements provided in the DoD SBIR Program BAA. Do not duplicate the electronically-generated Cover Sheet or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically-generated Cover Sheet and Cost Volume are excluded from the 20-page limit. Technical Volumes that exceed the 20-page limit will be reviewed only to the last word on the 20th page. Information beyond the 20th page will not be reviewed or considered in evaluating the offeror’s proposal. To the extent that mandatory technical content is not contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-compliant and score it accordingly.

Content of the Technical Volume
The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Refer to the instructions provided in the DoD SBIR Program BAA for full details on content of the technical volume.

Cost Volume (Volume 3)
The Phase I amount must not exceed **$250,000**. Costs must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DHA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement Officer.

Travel must be justified and relate to the project needs for direct Research Development Test & Evaluation (RDT&E) Technology Readiness Level (TRL) increasing costs. Travel costs must include the purpose of the trip(s), number of trips, origin and destination, length of trip(s), and number of personnel.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by DHA during proposal evaluations.

Supporting Documents (Volume 5)
DHA SBIR will accept a Volume Five (Supporting Documents) as required under the DoD SBIR Program BAA.

Fraud, Waste and Abuse Training Certification (Volume 6)
DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Phase II is the demonstration of the technology found feasible in Phase I. All DHA SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHA SBIR PMO. Submission instructions are typically sent in month five of the Phase I contract. The awardees will receive a Phase II window notification via email with details on when, how and where to submit their Phase II proposal.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (https://www.dodsbirsttr.mil/submissions/login). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, the Technical Volume, Supporting Documents, and Fraud, Waste, and Abuse certificate.

The DHA SBIR Program will evaluate and select Phase II proposals using the evaluation criteria in the DoD SBIR Program BAA. Due to limited funding, the DHA SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. Small businesses submitting a proposal are required to develop and submit a Commercialization Strategy describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal. This plan shall be included in the Technical Volume.

The Cost Volume must contain a budget for the entire 24-month Phase II period not to exceed the maximum dollar amount of $1,300,000.

Budget costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and shall be presented side-by-side on a single Cost Volume Sheet.
DHA SBIR Phase II Proposals have six Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume, Company Commercialization Report, Supporting Documents, and Fraud, Waste, and Abuse. The Technical Volume has a **40-page** limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically- generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

Technical Volumes that exceed the 40-page limit will be reviewed only to the last word on the 40th page. Information beyond the 40th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 40 pages of the proposal, the evaluator may deem the proposal as non-compliant and score it accordingly.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
The DHA SBIR Program **does not** participate in the Technical and Business Assistance (formerly the Discretionary Technical Assistance Program). Contractors shall not submit proposals that include Technical and Business Assistance.

The DHA SBIR Program has a Technical Assistance Advocate (TAA) who provides technical and commercialization assistance to small businesses that have Phase I and Phase II projects.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

Proposing firms will be notified via email to the Corporate Official of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA.

Non-selected companies may request feedback within 15 calendar days of the non-select notification. The Corporate Official identified in the firm's proposal shall submit the feedback request to the SBIR Office at usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@health.mil. Please note feedback is provided in an official PDF via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral feedback will not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the feedback request.

NOTE: Feedback is not the same as a FAR Part 15 debriefing. Acquisitions under this solicitation are awarded via "other competitive procedures". Therefore, offerors are neither entitled to nor will they be provided FAR Part 15 debriefs.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award shall be submitted to:

Ms. Samantha L. Connors SBIR/STTR Chief, Contracts Branch 8
Contracting Officer
U.S. Army Medical Research Acquisition Activity
Email: Samantha.l.connors.civ@health.mil

AWARD AND CONTRACT INFORMATION

Phase I awards will total up to $250,000 for a 6-month effort and will be awarded as Firm-Fixed-Price Purchase Orders.

Phase II awards will total up to $1,300,000 for a 24-month effort and will typically be Firm-Fixed-Price contracts. If a different contracting type is preferred, such as cost-plus, the rational as to why must be included in the proposal.

Phase I and II awardees will be informed of contracting and Technical Point of Contact upon award.

ADDITIONAL INFORMATION

RESEARCH INVOLVING HUMAN SUBJECTS, HUMAN SPECIMENS/DATA, OR ANIMAL RESEARCH

The DHA SBIR Program highly discourages offerors from proposing to conduct Human Subjects, Human Specimens/Data, or Animal Research during Phase I due to the significant lead time required to prepare regulatory documentation and secure approval, which could substantially delay the performance of the Phase I award. While technical evaluations will not be negatively impacted, Phase I projects requiring Institutional Review Board approval may delay the start time of the Phase I award. If necessary regulatory approvals are not obtained within two months of notification of selection, the decision to award may be terminated.

Offerors are expressly forbidden to use, or subcontract for the use of, laboratory animals in any manner without the express written approval of the U.S. Army Medical Research and Development Command (USAMRDC) Animal Care and Use Review Office (ACURO). Written authorization to begin research under the applicable protocol(s) proposed for this award will be issued in the form of an approval letter from the USAMRDC ACURO to the recipient. Modifications to previously approved protocols require re-approval by ACURO prior to implementation.

Research under this award involving the use of human subjects, to include the use of human anatomical substances or human data, shall not begin until the USAMRDC's Office of Human and Animal Research Oversight (OHARO) provides formal authorization. Written approval to begin a research protocol will be issued from the USAMRDC OHARO, under separate notification to the recipient. Written approval from the USAMRDC OHARO is required for any sub-recipient using funds from this award to conduct research involving human subjects. If the Offeror intends to submit research funded by this award to the U.S. Food and Drug Administration, Offerors shall propose a regulatory strategy for review.

Non-compliance with any provision may result in withholding of funds and or termination of the award.

WAIVERS

In rare situations, the DHA SBIR Program allows for a waiver to be incorporated allowing federal facility usage for testing/evaluation. A waiver will only be permitted when it has been determined that no applicable U.S. facility has the ability or expertise to perform the specified work. The DHA SBIR

Program has the right of refusal. If approved, the DHA SBIR Program will assist in establishing the waiver for approval. If approved, the proposer will subcontract directly with the federal facility and not a third party representative.

Transfer of funds between a company and a Military Lab must meet the APAN 15-01 requirements that will be included in the Phase II submission instructions.

International Traffic in Arms Regulation (ITAR)
For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases, such as Phase III, if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

END

DHA SBIR 23.2 Phase I Topic Index

DHA232-001	Integrated Photonics-based Handheld Non-Contact Laser Near-Infrared Photoacoustic Imager
DHA232-002	Integrated Photonics-based Portable Non-Contact Laser Vital Signs Monitor
DHA232-003	Medical Simulations for Extreme Cold Weather Environments

DHA232-001 TITLE: Integrated Photonics-based Handheld Non-Contact Laser Near-Infrared Photoacoustic Imager

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casualty Care

OBJECTIVE: Design, build and validate a handheld non-contact Laser Near-Infrared Absorption and Photoacoustic Imager (ncNIRPA) in the form of a stand-alone lightweight handheld device, using laser-based measurements, absorption and vibrometry, having optics pathways constructed with integrated photonics technology.

DESCRIPTION: Exposure of military to explosions and explosive weapons frequently leads to blast injury, concussions and subconcussions comprising mild traumatic brain injury (mTBI), that has accompanying deleterious and sometimes long-term debilitating effects [1]. More than 449,000 U.S. servicemen suffered from TBIs since 2000, with 82% mTBI [2]. mTBI is often accompanied by intracranial hemorrhage and hematoma containing oxygenated hemoglobin (Hb) and deoxygenated Hb (deoxyHb), that are detectable by NIRS [3]. This project's objective is to employ state-of-the-art technology to produce a novel handheld non-contact laser NIR photoacoustic (PA) imager (ncNIRPA) [4] with real-time imaging capabilities exceeding conventional NIRS devices, and using eye-safe lasers. NIRS devices designed previously, eg. The InfraScan (InfraScan Inc. Philadelphia PA), are limited to a single optode for signal acquisition from a single head location at a time, and require repeated scalp contact [5]. Head burns or trauma complicate use of such NIRS devices. The ncNIRPA imager is a non-contact device. It is directed towards the skull but separated from it, will employ a pulsed NIR laser that is able to detect abnormal accumulation of deoxyHb, producing acoustic vibrations that can be detected through Laser Doppler Vibrometry (LDV), which, in turn, will enable PA imaging [6].

PHASE I: The main goal of Phase I is a feasibility study in the development of a handheld ncNIRPA device. The device laser beam pathways are to be implemented using integrated photonics. Initially, to prove feasibility, a physical, electronics, optical and circuit design of the final handheld ncNIRPA product should be completed as the first deliverable. The major components will include the laser diodes, silicon photonics for laser transmit and receive components, computer processor(s), circuit board, rechargeable battery, transmission antenna, an on/off power switch and display screen. It must be capable to reconstruct an image in near-real-time, i.e. >= 2 Hz, and store DICOM-formatted [8] images. The ncNIRPA should be designed to operate by battery for a minimum threshold of two hours prior to battery recharging or replacement. The physical design of the ncNIRPA must have a form factor of approximately the width and height of a cellphone and be appropriate for the rigors of battlefield use. A second deliverable is a CAD computer model of the imager, accompanied by a physical mock-up of the scanning device. If time
permits, a schematic should be developed of the image acquisition and reconstruction software methodology, identifying useful existing software or software to be programmed.

PHASE II: The overall objective of Phase II is to produce a fully operational prototype handheld ncNIRPA imager factor that can acquire images from a human head in tests, archive and display the images on the device itself and on external devices so one can retrieve the images from the archive and redisplay them. The first deliverable of Phase II is to produce prototype hardware based on the electronics and optical design of Phase I. This task will produce the first deliverable, a true-size prototype of the ncNIRPA that acquires LDV signals that can be observed on an oscilloscope. The next aim is the programming and testing of software for the imager. The aim of this stage is to produce a second deliverable that is an enhanced form of the first deliverable, now replete with fully operational software for the acquisition of LDV signals, reconstruction of greyscale images, and transmission of the images to an external handheld computer. All image data must be compliant with DICOM standards. Laser power deposition must be demonstrated to not exceed FDA guidelines. The next goal is the production of a fully functional prototype ncNIRPA imager in the desired form factor, complete with the computer software needed to perform signal acquisition and all functions for display, archiving and retrieving the acquired images. This device should be demonstrated to acquire NIR PA images from a healthy human head, under an IRB-approved research protocol. The human subject volunteers should represent a range of cultural backgrounds exhibiting different hair pigments and other hair qualities. The third deliverable is to provide one fully functional prototype, accompanied by validation test reports and other relevant reports and designs, and a proposed regulatory strategy that includes a clear plan on how FDA clearance will be obtained. Early FDA coordination may be considered to assist with regulatory strategy, analysis of manufacturability and commercialization strategy.

PHASE III DUAL USE APPLICATIONS: To add value, an aim would be to develop training software, sample input and manuals for the system. Due to the device's small size and likely modest price, the main target for the product is the mass commercial pre-hospital market, i.e., primary care physicians, clinics, and EMT use. Military use would primarily be in Roles One and Two. The regulatory strategy shall be refined and implemented for FDA submission and approval for technical use as an US device. In conjunction with FDA submission, the contractor may develop scaled up manufacturing of the technology that follows FDA quality regulations. Utility is enhanced if the device was easily able to transmit images from phone internet application(s), enabling teleradiology and potentially integrate with artificial intelligence.

REFERENCES:

1. McKee AC, ME Robinson, Military-related traumatic brain injury and neurodegeneration, Alzheimers Dement. 2014 June ; 10(3): S242–S253.
2. Agimi Y, LE Regasa, KC Stout, Incidence of traumatic brain injury in the US Military, 20102014. Mil Med 184(5-6) e233-41 (2019).
3. Boas D, MA Franceschini, Near infrared imaging, 2009, http://www.scholarpedia.org/w/index.php?title=Near_infrared_imaging&oldid=61624
4. Hosseinaee Z, M Le, K Bell, P Haji Reza, Towards non-contact photoacoustic imaging [review], Photoacoustics 20, 100207 (2020)
5. Calingo A, Innovative Scanner Designed to Save Marines' Lives on the Battlefield, Marine Corps Systems Command, https://www.marines.mil/News/News-Display/Article/1181027/innovative-scanner-designed-to-save-marines-lives-on-thebattlefield, 12 May 2017.
6. Binte A, E Attia, G Balasundaram, M Moothanchery, US Dinisha, R Bi, V Ntziachristos M Olivoa, A review of clinical photoacoustic imaging: Current and future trends, Photoacoustics 16, 100144 (2019)
7. Medical Imaging & Technology Alliance, https://www.dicomstandard.org

KEYWORDS: near-infrared, laser, vibrometry, photonics, imager, photoacoustic, hemorrhage, hematoma, intracranial, portable, non-contact, medical imaging

DHA232-002 TITLE: Integrated Photonics-based Portable Non-Contact Laser Vital Signs Monitor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casualty Care

OBJECTIVE: Design, build, and validate results of a non-contact Laser Vital Signs Monitor (ncLVSM) in the form of a stand-alone lightweight portable cellphone-sized self-steering laser vibrometry device, constructed using integrated photonics.

DESCRIPTION: Main vital signs (VS) consist of core body temperature (Tc), heart rate (HR; pulse), respiratory rate (RR) and blood pressure (BP) An extended set includes oxygen saturation (SpO2), level of consciousness, and pain. VS of battlefield wounded are critical for Medic's triage at the point-of-injury (POI) and monitoring during prolonged field care (PFC). Standard manual means for monitoring VS are inefficient when first responders are focused on priorities of hemorrhage cessation and wound care. One approach is to use non-contact VSMs. Non-contact VSMs have been developed recently with optical, radar, thermal, and Laser Doppler Vibrometry (LDV) technology, and passive and active acoustic sensing. These devices suffer an innate limitation due to steering and localization control, requiring either manual direction or a restriction in the subject's position (e.g. [1]). The ncLVSM created in this project will use integrated photonics-based optical, laser, and LDV technology [2] capable of steering using computer vision and learned-sensing control. LDV can make non-contact vibration measurements of a surface struck by a laser [3]. It was shown [4] that LDV with manual steering can record a patient's Arterial Waveform (AWF) when signal is acquired from a body pulse point. Analysis of the AWF signal [5,6] yields HR and BP (as systolic BP (SBP) and diastolic BP (DBP)). The patient's RR is interrogated from signals acquired from chest expansions. The Tc is computed from the HR using for example the ECTemp algorithm [7] or another multi-wavelength thermography technique. The ncLVSM will include an onboard camera and computer, then use computer vision incorporating pose recognition [8-10] to steer the interrogation laser beams. Pulse points are located by morphing a gender-specific standard anatomy surface mesh with labeled pulse points onto the patient's body surface, with locations adjusted for movement by tracking software. ncLVSM is intended to operate hands-free, for example, attached to the front of a first-responder's jacket, helmet, or unmanned aerial vehicle.

PHASE I: The main goal of Phase I is a feasibility study in the development of a portable ncLVSM device. The ncLVSM must be designed to acquire data to compute the Tc, HR, RR and BP as SBP and DBP. The major components of the ncLVSM are to include the laser diode, silicon photonics for laser transmit and receive components, camera, computer processor(s), circuit board, rechargeable battery, transmission antenna, on/off power switch and small alphanumeric display screen. A thermally sensitive camera is an optional feature for nighttime pose recognition. As the first deliverable, a physical, electronics, optical, photonics and circuit design of the final ncLVSM product is to be completed to prove feasibility. The designs may include commercial components accompanying custom-designed photonics components. The physical design of the ncLVSM must have a form factor of approximately the width and height of a cellphone, must be appropriate for rugged civilian or battlefield applications, and must operate throughout the range of arctic to desert temperatures. The ncLVSM should operate by battery for a minimum of two hours of combined time use prior to battery recharging or replacement. Innovation is encouraged in each design aspect to create a lighter, more rugged, longer charged device. The device is to contain a computer processor(s) capable of performing the computations necessary to redirect the laser beam for locating and tracking a pulse point in case of movement. The VS should be computed at approximately 1Hz, displayed on the device, transmitted to external devices in real-time, and stored for later download. A second deliverable is a CAD computer model of the device, accompanied by a physical 3D printed model of the device. A third deliverable is a schematic description of the data acquisition process and software for each task. Existing software and planned software in the scheme should be indicated. A practically attainable AWF analysis methodology must be described.

PHASE II: The overall objective of Phase II is to produce one fully operational portable ncLVSM prototype. The prototype device must perform these tasks: recognize the subject body form; recognize the body pose; morph the body surface mesh of standard anatomy into the form of the patient; locate the pulse points on the patient from labels on the standard body mesh; acquire AWF VS; acquire signal from chest expansions; display the VS; store the information; decide if information is to be transmitted to an external device; and, continuously repeat this process. The first goal of Phase II is to produce a prototype hardware based on the silicon photonics and electronics design of Phase I. The emphasis should be focused on hardware integration and operation during this stage. This task will produce the first deliverable, a functioning prototype of the ncLVSM that acquires observable LDV signals from an inanimate phantom. The project then requires the design and programming of software operations detailed above. A second deliverable is the demonstration of the fully functional prototype ncLVSM in the desired cellphone form factor, complete with the computer software needed to perform signal acquisition and all functions for computation, display, data storage and transmission. Laser power deposition must be demonstrated to not exceed FDA guidelines. The ncLVSM must be demonstrated to acquire data from a human subject, under an IRB-approved research protocol. Subject movement should be included to demonstrate operation in non-static conditions. The third deliverable consists of 1) Providing one fully functional prototype ncLVSM device, accompanied by details of the electronics and integrated photonics design. 2) All software code that includes validation test reports and other relevant reports. 3) A regulatory strategy that reflects a clear plan on how FDA clearance will be obtained.

Early FDA coordination may be considered to assist with the regulatory strategy for obtaining approval for use as a medical monitoring device.

PHASE III DUAL USE APPLICATIONS: An aim would be to develop training software, sample input and create manuals for the system. Due to the device's small size and likely modest price, the main target for the product is the mass commercial market, i.e. primary care physicians, clinics, and EMT use. ncLVSM use when mounted on an UAV, to provide an unmanned triage capability, is another application for both the military and civilian markets. This phase shall include FDA submission with the goal of FDA approval. In conjunction with FDA submission, the contractor can develop scaled up manufacturing of the technology that follows FDA quality regulations. Utility is enhanced if the device was easily able to transmit VS data in a manner to be accessible to phone internet application(s), enabling telemedicine and potentially integrating with artificial intelligence.

REFERENCES:

8. "Laser can detect your heartbeat and breathing from a metre away", New Scientist, May 16, 2018.
9. Li Y, L Marais, H Khettab, Z Quan, A Aasmul, R Leinders, R Schuler, PE Morrissey, S Greenwald, P Segers, M Vanslembouck, RM Bruno, P Boutyrie, P O'Brien, M De Melis, R Baets, Silicon photonics-based laser Doppler vibrometer array for carotid-femoral pulse wave velocity (PWV) measurement, Biomedical Optics Express 11(7) 3913- 3926 (2020).
10. Kroschel, Kristian, Laser Doppler Vibrometry for Non-Contact Diagnostics, Springer Bioanalysis Series, 2020
11. Desjardins, CL, LT. Antontelli, E Soares, A remote and non-contact method for obtaining the blood-pulse waveform with a laser Doppler vibrometer, Proc SPIE 6430, Advanced Biomedical and Clinical Diagnostic Systems V, 64301C (6 Feb 2007).
12. Esper SA, MR Pinsky, Arterial Waveform Analysis, Best Practice & Research Clinical Anaesthesiology 28, 363-380 (2014).
13. Nirmalan M, PM Dark, Broader analysis of arterial pressure wave form analysis, Continuing Education in Anaethesia, Critical Care & Pain 14(6), 285-290 (2014)

14. Hunt, AP, MJ Buller, MJ Maley, JT Costello, IB Stewart, Validity of a noninvasive estimation of deep body temperature when wearing personal protective equipment during exercise and recovery, Mil Med Res 6: 2, 2019.
15. Shotton, J, A Fitzgibbon, M Cook, T Sharp, M Finocchio, R Moore, A Kipman, A Blake, Real-Time Human Pose Recognition in Parts from Single Depth Images, Computer Vision and Pattern Recognition 2011, 12897-1304, 2011.
16. Gamra, Ben, Miniar, Moulay A.Akhloufi, A review of deep learning techniques for 2D and 3D human pose estimation, Image and Vision Computing, 114, 104282, 2021.
17. Wang, J, STan, Xg Zhen, S Xu, F Zheng, Z He, L Shao, Deep 3D human pose estimation: A review, Computer Vision and Image Understanding, 210 193225, 2021.

KEYWORDS: Laser, vibrometry, vital signs, biosensor, photonics, portable, self-steering, noncontact, monitor.

DHA232-003 TITLE: Medical Simulations for Extreme Cold Weather Environments

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casualty Care

OBJECTIVE: Develop and test proof-of-concept systems for training military medics to identify and treat various injuries in extreme cold weather environments.

DESCRIPTION: During Operations Enduring Freedom and Iraqi Freedom, Army Combat medics centered a great deal of their training on injuries due to improvised explosive devices and gunshot wounds (Dougherty, Mohrle, Galarneau, Woodruff, Dye, and Quinn, 2009). The focus of this topic is training military medics for extreme cold weather environments. Two parallel areas of concern are hardening simulations to withstand extreme cold and providing training for non-battlefield injuries such as hypothermia and frostbite (Army Public Health Center, 2022).

Highlighting the need across the services for a more collaborative approach to extreme cold warfighting capabilities, the DoD established the Ted Stevens Center for Arctic Security Studies on 9 June 2021 (DoD Fact Sheet, 2021.)

Medics need to be able to identify what an injury is as well as know how to treat it. The former requires cognitive understanding and diagnostic ability, while the latter requires hands-on practice. Current patient simulators and part task trainers often fail in extreme cold due to shortened battery life, simulated skin becoming fragile, fluids (e.g., simulated blood) freezing, and electronics failing (J. Pederson, personal communications, September 12, 2022). Diagnosis and treatment cannot be limited to “point of injury”, but should include prolonged care, should the medic be required to treat the patient for extended periods of time.

PHASE I: Phase I will result in proof-of-concept “breadboard” training systems for two or more extreme cold weather injuries that will operate in an extreme cold environment. Phase I of this effort will begin with a detailed analyses of various types of extreme cold weather injuries, difficulties treating injuries in extreme cold, and weather-related materiel issues (e.g., fluids, electronics, simulated tissue). Each analysis should include how best to train medics to initially diagnose and treat the injury, as well as what to expect from the injury over the course of 24 – 72 hours. Each analysis should also explore how best to train both diagnosis and treatment (e.g., part-task trainer, moulage on human standard patients, AR/VR/MR, or combinations). The resulting training proof-of-concept system should demonstrate solutions to the problems found during the initial analyses conducted at the start of this Phase I.

PHASE II: Successful Phase II offeror(s) will develop proof-of-concept systems as described in Phase I into well-defined, tested, and documented systems that can train military medical caregivers to diagnose and treat selected extreme environment injuries, both at point of injury and in a prolonged care situation. Note that prolonged care does not necessarily imply field conditions; a patient can spend prolonged time in a Battalion Aid Station or Forward Surgical Hospital. Resulting systems must be designed with affordability, training effectiveness and usability, in terms of reduced instructor workload, in mind. Phase II will also explore linkages to the Synthetic Training Environment (Synthetic Training Environment, 2021). As pertinent to the Phase II prototype, offerors should also examine and rate leading human physiology engines on their ability to simulate physiological reactions to extreme cold. Offerors will provide a technical approach for integrating physiology engines into the prototype system during Phase III.

During Phase II, the utility and maturity of the system should be demonstrated to military medical instructors. A training effectiveness evaluation using a relevant population should also be performed at a relevant military medical training center/schoolhouse. Ideally, the Phase II system should be demonstrated at a cold-weather exercise, such as Arctic Edge or Cold Response.

PHASE III DUAL USE APPLICATIONS: During Phase III, the offeror will “harden” the system, ensuring it adheres to the latest Department of Defense cyber security requirements. In addition, user improvement suggestions gathered during Phase II shall be incorporated, as deemed appropriate by the Phase III funding customer. The resulting system will be well documented. Working with the Defense Medical Modeling and Simulations Office, the Ted Stevens Center for Arctic Security Studies, and service organizations involved in cold weather and extreme environments (e.g., 11th Airborne Division, 10th Mountain Division, Marine Corps Mountain Training Center, Fort McCoy’s Cold Weather Operations Course), the topic proponent will seek potential funding partners.
In parallel to working with transition partners, Phase III should include pursuing commercialization opportunities. Emergency medical facilities in austere environments involving high altitude and/or extreme cold could benefit from the same technologies. Civilian organizations training/certifying Wilderness Emergency Medical Technicians are potential customers.

REFERENCES:

18. Army Public Health Center (2022). Cold weather casualties and injuries. Retrieved November 18, 2022 from https://phc.amedd.army.mil/topics/discond/cip/Pages/Cold-Weather-Casualties-and-Injuries.aspx
19. DoD Fact Sheet (2021). Ted Stevens Center for Arctic Security Studies: DoD’s Newest Regional Center. Retrieved January 25, 2023 from https://media.defense.gov/2021/Nov/17/2002894807/-1/-1/0/DOD-TSC-FACT-SHEET-(FINAL).PDF
20. Dougherty, A. L., Mohrle, C. R., Galarneau, M. R., Woodruff, S. I., Dye, J. L., & Quinn, K. H. (2009). Battlefield extremity injuries in operation Iraqi freedom. Injury, 40(7), 772-777.
21. Synthetic Training Environment (2021). Retrieved November 10, 2022 from https://ste-cft.org/.

KEYWORDS: Medical modeling and simulation, extreme weather medical training, cold weather medical training

VERSION 2

Defense Logistics Agency (DLA)
23.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Defense Logistics Agency's (DLA) mission has three lines of effort the DLA Small Business Innovation Program (SBIP) supports. They include supporting the **NUCLEAR ENTERPRISE** by maintaining nuclear systems readiness, qualifying alternate sources of supply, improving the quality of consumable parts, and increasing materiel availability. **FORCE READINESS & LETHALITY** through Improvements to life cycle performance through technological advancement, innovation, and reengineering, mitigate single points-of-failure that threaten the readiness of weapons systems used by our Warfighters. **SUPPLY CHAIN INNOVATION & ASSURANCE** through improved lead times, reduced lifecycle costs, maintaining a secure and resilient supply chain, providing opportunities for the small business industrial base to enhance supply chain operations with technological innovations. Lastly supply chain assurance securing the microelectronics supply chain, development of a domestic supply chain for rare earth elements, the adoptions of industrial base best practices associated with counterfeit risk reduction.

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DLA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

Specific questions pertaining to the administration of the DLA Program and these proposal preparation instructions should be directed to:

Defense Logistics Agency
Small Business Innovation Program (SBIP) Office DLA/J68
Email: DLASBIR2@DLA.mil

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA. https://www.dodsbirsttr.mil/submissions/login

Technical Volume (Volume 2)

DLA's objective for the Phase I effort is to determine the merit and technical feasibility of the concept. The technical volume is not to exceed twenty pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages submitted beyond the 20-page limit within the Technical Volume (Volume 2) will not be evaluated. If including a letter(s) of support, they should be included in Volume 5, and they will not count towards the 20-page Volume limit. Any technical data/information that should be in the Volume 2 but is contained in other Volumes will not be considered.

Content of the Technical Volume
Refer to the instructions provided in the DoD Program BAA.

Cost Volume (Volume 3)
A list of topics currently eligible for proposal submission is included in these instructions, followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. Refer to the topic for cost and duration structure. Proposers must utilize the excel cost volume provided during proposal submission on DSIP.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DLA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD Program BAA for full details on this requirement. Information contained in the CCR will be considered by DLA during proposal evaluations.

Supporting Documents (Volume 5)
Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3). Please refer to the DoD Program BAA for details on required Supporting Documents.

Additional DLA-specific supporting documents:

- Optional, A qualified letter of support is from a relevant commercial or Government Agency procuring organization(s) working with DLA, articulating their pull for the technology (i.e., what DLA need(s) the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program.
- Letters of support shall not be contingent upon award of a subcontract.

The standard formal deliverables for a Phase I are the:

- Plan of Action and Milestones (POAM) with sufficient detail for monthly project tracking.
- Initial Project Summary: one-page, unclassified, non-sensitive, and non-proprietary summation of the project problem statement and intended benefits (must be suitable for public viewing).
- Monthly Status Report. A format will be provided at the PAC.
- The TPOC and PM will determine a meeting schedule at the PAC. Phase I awardees can expect Monthly (or more frequent) Project Reviews.
- Draft Final Report including major accomplishments, business case analysis, commercialization strategy, transition plan with timeline, and proposed path forward for Phase II.
- Final Report including major accomplishments, business case analysis, commercialization strategy and transition plan with timeline, and proposed path forward for Phase II.
- Final Project Summary (one-page, unclassified, non-sensitive and non-proprietary summation of project results, high resolution photos or graphics intended for public viewing)
- Applicable Patent documentation
- Other Deliverables as defined in the Phase I Proposal
- Phase II Proposal is optional at the Phase I Awardee's discretion (as Applicable)

DIRECT TO PHASE II PROPOSAL GUIDELINES

VERSION 2

15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY allows the Department of Defense to make an award to a Small Business Concern (SBC) under Phase II of the SBIR Program with respect to a project, without regard to whether the small business concern received an award under Phase I of an SBIR Program with respect to such project.

DLA is conducting a "Direct to Phase II" implementation of this authority for topic **DLA232-D07**. This pilot does not guarantee DLA will offer any future Direct to Phase II opportunities.

PROJECT DURATION and COST:

Direct to PHASE II: **-** Not to exceed $1,800,00, unless restricted by the specific topic author/sponsor

PERIOD OF PERFORMANCE: The Direct to Phase II period of performance is not to exceed 24 months total.

INTRODUCTION

Direct to Phase II proposals must follow the steps outlined in the following statements.

1. Offerors must provide documentation that satisfies the Phase I feasibility requirement*.
   - This documentation will comprise the first twenty pages of Volume 2 (Technical Volume) of the Direct to Phase II proposal
2. Offerors must submit a complete Phase II proposal using the DLA Phase II proposal instructions below.

* NOTE: Offerors are required to provide information demonstrating that the scientific and technical merit and feasibility. DLA will not evaluate the corresponding Phase II proposal if it determines that the offeror has failed to demonstrate the establishment of technical merit and feasibility.

PROPOSAL SUBMISSION

Submit the complete proposal electronically at https://www.dodsbirsttr.mil/submissions/login

Complete proposals must include all of the following:

a. Volume 1: DoD Proposal Cover Sheet, Produced in the DSIP System by your company profile.
b. Volume 2: Technical proposal
   Part 1: Phase I Justification (20 Pages Maximum)
   Part 2: Phase II Technical Proposal (40 Pages Maximum)
c. Volume 3: Cost Volume (Excel spreadsheet upload)
d. Volume 4: Company Commercialization Report
e. Volume 5: Additional Documents (Optional)
f. Volume 6 FWA Training Certificate is required for proposal submission.

Phase II proposals require a comprehensive, detailed submission of the proposed effort. Commercial and military potential of the technology under development is extremely important. Successful proposals will emphasize applicability to specific DOD programs of record as well as dual- use applications and commercial exploitation of resulting technologies.

Direct to Phase II PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

VERSION 2

PROPOSAL FORMAT

A. Cover Sheet. This is completed using the DSIP Portal on the Submission Site. This is a compilation of company data as well as specific information regarding the proposed project. Include a brief description of the problem or opportunity, objectives, effort, and anticipated results. Summarize the expected benefits, as well as any government or private sector applications of the proposed research. OSD and SBA will post the Project Summary of selected proposals with unlimited distribution. Therefore, the summary should not contain any classified or proprietary information.

B. Technical Volume (60 pages total maximum)

- Phase I Justification (20 Pages Maximum). Offerors are required to provide information demonstrating the establishment of the scientific and technical merit and feasibility.

- Phase II Technical Objectives and Approach (40 Pages Maximum). List the specific technical objectives of the Phase II research and describe the planned technical approaches used to meet these objectives.

- Phase II Work Plan. Provide an explicit, detailed description of the Phase II approach. The plan should indicate how and where the firm will conduct the work, a schedule of major events, and the final product to be developed. The Phase II effort should attempt to accomplish the technical feasibility demonstrated in the justification, including potential commercialization results. Phase II is the principal research and development effort and is expected to produce a well-defined deliverable product or process.

- Related Work. Describe significant activities directly related to the proposed effort, including those conducted by the Principal Investigator, the proposing firm, consultants, or others. Report how the activities interface with the proposed project and discuss any planned coordination with outside sources. The proposers must demonstrate an awareness of the state-of-the-art in the technology and associated science.

- Relationship with Future Research or Research and Development. State the anticipated results of the proposed approach if the project is successful. Discuss the significance of the Phase II effort in providing a foundation for a Phase III research or research and development effort.

- Technology Transition and Commercialization Strategy. Describe your company's strategy for converting the proposed SBIR research, resulting from your proposed Phase II contract, into a product or non-R&D service with widespread commercial use -- including private sector and/or military markets. Note that the commercialization strategy is separate from the Commercialization Report described in Section 4.L below. The strategy addresses how you propose to commercialize this research, while the Company Commercialization Report covers what you have done to commercialize the results of past Phase II awards. Historically, a well-conceived commercialization strategy is an excellent indicator of ultimate Phase III success. The commercialization strategy must address the following questions:

- What DoD Program and/or private sector requirement does the technology propose to support?
- What customer base will the technology support, and what is the estimated market size?
- What is the estimated cost and timeline to bring the technology to market to include projected funding amount and associated sources?
- What marketing strategy, activities, timeline, and resources will be used to enhance commercialization efforts??
- Who are your competitors, and describe the value proposition and competitive advantage over the competition?

- Key Personnel. Identify key personnel, including the Principal Investigator, who will be involved in the Phase II effort. List directly related education and experience and relevant publications (if any) of key personnel. Include a concise resume of the Principal Investigator(s).

- Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Justify the purchase of any items or equipment (as detailed in the cost proposal) including Government Furnished Equipment (GFE). All requirements for government furnished equipment or other assets, as well as associated costs, must be determined and agreed to during Phase II contract negotiations. State whether or not the proposed work facilities will be performed meet environmental laws and regulations of federal, state (name) and local governments. This includes, but is not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal, and handling and storage of toxic and hazardous materials.

- Consultants. Involvement of university, academic institution, or other consultants in the project may be appropriate. If the firm intends to involve these types of consultants, describe these costs in detail in the Cost Volume.

C. **Cost Volume**. Download, complete, and upload the Spreadsheet. Some items in the cost volume template may not apply to the proposed project. Provide enough information to allow the DLA evaluators to assess the proposer's plans to use the requested funds if DLA were to award the contract.

- List all key personnel by name as well as number of hours dedicated to the project as direct labor.
- Special Tooling, Test Equipment, and Materials Costs:
- Special tooling, test equipment, and materials costs may be included under Phase II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed; and
- The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate it directly to the specific effort.
- Cost for travel funds must be justified and related to the needs of the project.

D. **Company Commercialization Report (CCR).** Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DLA during proposal evaluations.

VERSION 2

METHOD OF SELECTION AND EVALUATION CRITERIA

Evaluation Criteria. DLA will review all proposals for overall merit based on the evaluation criteria published in the DoD SBIR Program BAA.

CONTRACTUAL CONSIDERATIONS

A. Awards. The number of Direct to Phase II awards will depend upon the quality the Phase II proposals and the availability of funds. Each Phase II proposal selected for award under a negotiated contract requires a signature by both parties before work begins. DLA awards Phase II contracts to Small Businesses based on results of the agency priorities, scientific, technical, and commercial merit of the Phase II proposal.

B. Reports. For incrementally funded Direct to Phase II projects an interim, midterm written report maybe required (at the discretion of the awarding agency).

C. Payment Schedule. DLA Phase II Awards are Firm Fixed Price / Level of Effort contracts. Base monthly invoices on the labor hours recorded PLUS the monthly costs associated with the project.

D. Markings of Proprietary Information. In accordance with DoD SBIR Program BAA, DLA does not accept classified proposals. All Final Reports are marked with CUI // SBIZ// FEDONLY, and the Initial Project Summary as well as the Final Project Summary should reference compliance with FOR PUBLIC RELEASE.

E. Copyrights, Patents and Technical Data Rights. DLA handles all Copyrights, Patents, and Technical Data Rights in accordance with the guidelines in the DoD SBIR Program BAA.

TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The DLA SBIR Program does not participate in the Technical and Business Assistance (formally the Discretionary Technical Assistance Program). Contractors should not submit proposals that include Technical and Business Assistance.

PHASE II PROPOSAL GUIDELINES

Per SBA SBIR Phase II Proposal guidance, **all** Phase I awardees are permitted to submit a Phase II proposal for evaluation and potential award selection, without formal invitation. Details on the due date, format, content, and submission requirements of the Phase II proposal will be provided by the DLA SBIP PMO on/around the midway point of the Phase I period of performance. Only firms who receive a Phase I award may submit a Phase II proposal.

DLA will evaluate and select Phase II proposals using the same criteria as Phase I evaluation. Funding decisions are based upon the results of work performed under a Phase I award, the Scientific & Technical Merit, Feasibility, and Commercial Potential of the Phase II proposal; Phase I final reports may be reviewed as part of the Phase II evaluation process. The Phase II proposal should include a concise summary of the Phase I effort including the specific technical problem or opportunity addressed and its importance, the objective of the Phase I effort, the type of research conducted, findings or results of this research, and technical feasibility of the proposed technology.

Due to limited funding, DLA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Phase II Proposals should anticipate a combination of any or all the following deliverables:

- Plan of Action and Milestones (POAM) with sufficient detail for monthly project tracking
- Initial Project Summary: one-page, unclassified, non-sensitive, and non-proprietary summation of the project problem statement and intended benefits (must be suitable for public viewing)
- Monthly Status Report. A format will be provided at the PAC.
- Meeting schedule to be determined by the Technical Point of Contact (TPOC) and PM at the PAC
- Phase II awardees expect Monthly (minimum) Project Reviews (format provided at the PAC)
- Draft Final Report including major accomplishments, commercialization strategy and transition plan and timeline.
- Final Report including major accomplishments, commercialization strategy, transition plan, and timeline.
- Final Project Summary (one-page, unclassified, non-sensitive and non-proprietary summation of project results, non-proprietary high-resolution photos, or graphics intended for public viewing)
- Applicable Patent documentation.
- Other Deliverables as defined in the Phase II Proposal.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
DLA is not authorizing TABA at this time.

EVALUATION AND SELECTION

Use of Support Contractors in the Evaluation Process

Only Government personnel with active non-disclosure agreements will officially evaluate proposals.

Non-Government technical consultants (consultants) to the Government may review and provide support in proposal evaluations during source selection.

Consultants may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. Consultants will not establish final assessments of risk and will not rate or rank offerors' proposals. They are also expressly prohibited from competing for DLA SBIR awards in the SBIR topics they review and/or on which they provide comments to the Government.

All consultants are required to comply with procurement integrity laws. Consultants will not have access to proposals or pages of proposals that are properly labeled by the offerors as "FEDONLY." Pursuant to FAR 9.505-4, DLA contracts with these organizations include a clause which requires them to

(1) Protect the offerors' information from unauthorized use or disclosure for as long as it remains proprietary and

(2) Refrain from using the information for any purpose other than that for which it was furnished. In addition, DLA requires the employees of those support contractors that provide technical analysis to the SBIR/STTR Program to execute non-disclosure agreements. These agreements will remain on file with the DLA SBIP PMO.

VERSION 2

Non-Government consultants will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. In accomplishing their duties related to the source selection process, employees of the organizations may require access to proprietary information contained in the offerors' proposals.

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. DLA will evaluate and select Phase I and Phase II proposals using scientific review criteria based upon technical merit and other criteria as discussed in this Announcement document.

- DLA reserves the right to award none, one, or more than one contract under any topic.
- DLA is not responsible for any money expended by the offeror before award of any contract.
- Due to limited funding, DLA reserves the right to limit awards under any topic.
- Only proposals considered to be "Highly Acceptable" as determined by DLA will be funded.

Please note that potential benefit to the DLA will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Technical reviewers will base their conclusions only on information contained in the proposal. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be listed in the proposal and will count toward the applicable page limit.

Final Selection may require an oral presentation. This may include an in-person meeting or a Zoom.gov meeting.

The two-part evaluation process is explained below:

Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in the DoD SBIR BAA. Once the initial evaluations are complete, all Offerors will be notified as to whether they were selected to present the slide deck portion of their proposal within 60 days of the BAA close date. Only proposals receiving a "Highly Acceptable" rating will receive an invitation to present orally.

Part II: If selected for an oral presentation, Offerors shall submit a slide deck not to exceed 15 PowerPoint slides to DLASBIR@dla.mil.

- There are no set format requirements other than the 15-page maximum page length.
- It is recommended (but not required) that more detailed information is included in the technical volume and higher-level information is included in the slide deck.

Selected Offerors will receive an invitation to present a slide deck (15-minute presentation time / 15-minute question and answer) in a technical question and answer forum to the DLA evaluation team via electronic media. This presentation will be evaluated by a panel against the criteria listed above and your overall presentation. DLA will evaluate the presentation for Business Acumen, and Core Business Capabilities (Customer Engagement / Presentation Skills). The rating of the presentation will be a Go/No-Go rating.

Notification of the Go/No-Go rating decision will occur within 5 days of the presentation. Input on technical aspects of the proposals may be solicited by DLA from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements.

The SBIP PMO will distribute selection and non-selection email notices to all firms who submit a SBIR/STTR proposal to DLA. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet. DLA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission. DLA will distribute the selection and non-selection notifications to all offerors within 90 days of the BAA close date.

DLA will provide written feedback to unsuccessful offerors regarding their proposals on the non-selection notification. Only firms that receive a non-selection notification are eligible for written feedback.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: DCSO Small Business Innovation Program SBIP.DCSO@dla.mil. This is the DLA Contracting Team workflow email address.

AWARD AND CONTRACT INFORMATION

Typically, the contract period of performance for Phase I should be up to twelve (12) months and the award should not exceed $100,000. However, each topic may have a different threshold. The DLA Contracting Office utilizes a Firm Fixed Price (FFP) Contract for DLA Phase I Projects

The expected budget for Phase II should not exceed $1,000,000 unless approved by the DLA Program Manager, and the duration should not exceed 24 Months. Proposals in excess of $1,000,000 will not be considered without written PM approval. The DLA Contracting Office utilizes a Firm Fixed Price Level of Effort (FFP/LOE) Contract for DLA Phase II Projects.

Proposals not conforming to the terms of this Announcement will not be considered. DLA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DLA will be funded.

DLA reserves the right to withdraw from negotiations at any time prior to contract award.

Post Award, DLA may terminate any award at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

Please read the entire DoD Announcement and DLA instructions carefully prior to submitting your proposal. Please go to https://www.sbir.gov/about/about-sbir#sbir-policy-directive to read the SBIR/STTR Policy Directive issued by the Small Business Administration.

USE OF FOREIGN NATIONALS (also known as Foreign Persons), GREEN CARD HOLDERS AND DUAL CITIZENS

If proposing to use foreign nationals (also known as foreign persons), they must be green card holders, and/or dual citizens. (No Student or Temporary Visa holders will be approved). The offeror must identify the personnel they expect to be involved on this project, the type of visa or work permit under which they are performing, country of origin and level of involvement.

You will be asked to provide additional information during negotiations to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted to export control-restricted topics and/or those with foreign nationals, dual citizens, or green card holders listed will be subject to security review during the contract negotiation process (if selected for award).

DLA reserves the right to vet all uncleared individuals involved in the project, regardless of citizenship, who will have access to Controlled Unclassified Information (CUI) such as export controlled information. If the security review disqualifies a person from participating in the proposed work, the contractor may propose a suitable replacement.

In the event a proposed person and/or firm is found ineligible by the government to perform proposed work, the contracting officer will advise the offeror of any disqualifications but is not required to disclose the underlying rationale.

V. EXPORT CONTROL RESTRICTIONS

The technology within most DLA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. The offeror must ensure that their firm complies with all applicable export control regulations. Please refer to the following URLs for additional information: https://www.pmddtc.state.gov/ and https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear.

Most DLA SBIR topics are subject to ITAR and/or EAR. If the topic write-up indicates that the topic is subject to International Traffic in Arms Regulation (ITAR) and/or Export Administration Regulation (EAR), your company may be required to submit a Technology Control Plan (TCP) during the contracting negotiation process.

CLAUSE H-08 PUBLIC RELEASE OF INFORMATION (Publication Approval)

Clause H-08 pertaining to the public release of information is incorporated into all DLA SBIR contracts and subcontracts without exception. Any information relative to the work performed by the contractor under DLA SBIR contracts must be submitted to DLA for review and approval prior to its release to the public. This mandatory clause also includes the subcontractor who shall provide their submission through the prime contractor for DLA's review for approval.

FLOW-DOWN OF CLAUSES TO SUBCONTRACTORS

The clauses to which the prime contractor and subcontractors are required to comply include but are not limited to the following clauses:

1) DLA clause H-08 (Public Release of Information),
2) DFARS 252.204-7000 (Disclosure of Information),
3) DFARS clause 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting), and
4) DFARS clause 252.204-7020 (NIST SP 800-171 DoD Assessment Requirements). Your proposal submission confirms that any proposed subcontract is in accordance with the clauses cited above and any other clauses identified by DLA in any resulting contract.
5) DFARS Clause 252.223-7999 Ensuring Adequate COVID-19 Safety Protocols for Federal Contractors

VERSION 2

OWNERSHIP ELIGIBILITY
Prior to award, DLA may request business/corporate documentation to assess ownership eligibility as related to the requirements of SBIR Program Eligibility. These documents include, but may not be limited to, the Business License; Articles of Incorporation or Organization; By-Laws/Operating Agreement; Stock Certificates (Voting Stock); Board Meeting Minutes for the previous year; and a list of all board members and officers.

If requested by DLA, the contractor shall provide all necessary documentation for evaluation prior to SBIR award. Failure to submit the requested documentation in a timely manner as indicated by DLA may result in the offeror's ineligibility for further consideration for award.

ADDITIONAL INFORMATION

Classified Proposals
Classified proposals **ARE NOT** accepted under the DLA SBIR Program. The inclusion of classified data in an unclassified proposal is grounds for the Agency to determine the proposal as non-responsive and the proposal not to be evaluated.

Contractors currently working under a classified contract must use the security classification guidance provided under that contract to verify new SBIR proposals are unclassified prior to submission.

Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on DLA SBIR/STTR contracts will require security clearances. If a DLA SBIR/STTR contract develops into or identifies classified work, the offeror must have a facility clearance, appropriate personnel clearances to perform the classified work and coordinate the DD254 with the Contract Officer and the service owning the classified data.

For more information on facility and personnel clearance procedures and requirements, please visit the Defense Counterintelligence and Security Agency Web site at: https://www.dcsa.mil.

Use of Acronyms
Acronyms should be spelled out the first time they are used within the technical volume (Volume 2), the technical abstract, and the anticipated benefits/potential commercial applications of the research or development sections. This will help avoid confusion when proposals are evaluated by technical reviewers.

Communication
All communication from the DLA SBIR/STTR PMO will originate from the DLASBIR2@DLA.mil email address. Please white list this address in your company's spam filters to ensure timely receipt of communications from our office.

All attachments sent via email require encryption. The firm will have to purchase ECA certificates to send and receive encrypted email if they do not have a CAC or PIV issued. The cost is approximately $100 per year per user. This will be a CMMC requirement for all future contracts.

ORGANIZATIONAL CONFLICTS OF INTEREST (OCI)
The basic OCI rules for Contractors which support development and oversight of SBIR topics are covered in FAR 9.5 as follows (the Offeror is responsible for compliance):

(1) the Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract.

(2) the Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) the Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All applicable rules under the FAR Section 9.5 apply.

If you, or another employee in your company, developed or assisted in the development of any SBIR requirement or topic, please be advised that your company may have an OCI. Your company could be precluded from an award under this BAA if your proposal contains anything directly relating to the development of the requirement or topic. Before submitting your proposal, please examine any potential OCI issues that may exist with your company to include subcontractors and understand that if any exist, your company may be required to submit an acceptable OCI mitigation plan prior to award.

PHASE III GUIDELINES & INSTRUCTIONS

Phase III is any proposal that "Derives From", "Extends" or completes a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLASBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply. More specific Instructions may be available when a firm submits a Phase III proposal.

VERSION 2

DLA 23.2 SBIR Phase I & Direct to Phase II Topic Index

VERSION 2

DLA232-001 TITLE: Engaging the Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear, Mission Readiness & Disaster Preparedness

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 the Announcement. 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: Expand the Small Business Manufacturer (SBM) base to address the Agency's need to develop qualified sources of supply to improve DLA product availability, provide competition for reduced lead time and cost, as well as address lifecycle performance issues. Through participation in DLA SBIR, SBMs will have an opportunity to collaborate with DLA Weapons System Program Managers (WSPMs) and our customer Engineering Support Activities (ESAs) to develop innovative solutions to DLA's most critical supply chain requirements. In the end, the SBM benefits from the experience by qualifying as a source of supply as well as from the business relationships and experience to further expand their product lines and readiness to fulfill DLA procurement requirements.

DESCRIPTION: Competitive applicants will have reviewed the parts list provided on DLA Small Business Innovation Program (SBIP) website, (Reference 4) as well as the technical data in the cFolders of DLA DiBBs, (Reference 3). Proposals can evolve in one of four ways depending on the availability of technical data and NSNs for reverse engineering as follows. Information on competitive status, RPPOB, and tech data availability will be provided on the DLA SBIP website, (Reference 4).

a. Fully Competitive (AMC/AMSC-1G) NSNs where a full technical data package is available in cFolders. The SBM proposal should reflect timeline, statement of work and costs associated with the manufacturing and qualification of a representative article.
b. Other than (AMC/AMSC-1G) NSNs where a full Technical Data Package (TDP) is available in cFolders. These items may also require a qualification of a Representative Article. The SBM proposal should reflect timeline, statement of work, and costs associated with producing a Source Approval Request (SAR) and (if applicable) qualification of a Representative Article. Contact the TPOC if necessary. The scope and procedures associated with development of a SAR package are provided in Reference 1.
c. Repair Parts Purchase or Borrow (RPPOB) or Surplus may be an option for other than 1G NSNs where partial or no technical data is available in cFolders. NSNs, if available, may be procured or borrowed through this program for the purposes of reverse engineering. The instructions for RPPOB can be found on the websites, Reference 5. The SBM proposal should reflect timeline, statement of work and costs associated with the procuring the part and reverse engineering of the NSN. Depending on complexity, producing both the TDP and SAR package may be included in Phase I.
d. Reverse Engineering (RE) without RPPOB or Surplus available is when the NSN will be provided as Government Furnished Material (GFM) if available from the ESA or one of our Service customers post award. In this case, contact the TPOC to discuss the availability of the NSN prior to starting the proposal.

Typically, a competitive SBM will have relevant experience in producing a similar item which will enable them to propose without a representative article. The SBM proposal should reflect timeline, statement of

work and costs associated with the reverse engineering of the NSN and depending on complexity producing a TDP and SAR package in Phase I.
Specific parts may require minor deviations in the process dependent on the Engineering Support Activity (ESA) preferences and requirements. Those deviations will be addressed post award
.
PROJECT DURATION and COST:
PHASE I: NTE 12 Months $100K. The project schedule should plan to complete the TDP and SAR in the first six months.
PHASE II: NTE 24 Months $1M.

The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation and engineering capability and the availability of appropriate requirements. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.
Participating small businesses must have an organic manufacturing capability and a Commercial and Government Entity (CAGE) code and be Joint Certification Program (JCP) certified in order to access technical data if available.

Refer to "link 2" below for further information on JCP certification. Additionally, small businesses will need to create a DLA's Internet Bid Board System (DIBBS) account to view all data and requirements in C Folders.

Refer to "links 3 and 4" below for further information on DIBBS and C Folders. All available documents and drawings are located in the C Folder location "SBIR231A". If the data is incomplete, or not available, the effort will require reverse engineering.

PHASE I: Not to exceed - 12 months - $100K
The goal of phase I is for the Small Business Manufacturer to qualify as a source of supply for the DLA NSN(s) to improve DLA NSN availability, provide competition for reduced lead time and cost, and address lifecycle performance issues. In this phase, manufacturers will request TDP/SAR approval from the applicable Engineering Support Activity (ESA), as required, for the NSN(s). At the Post Award Conference, the awardee will have the opportunity to collaborate with program, weapon system, and/or engineering experts on the technical execution and statement of work provided in their proposal.
All Phase I Proposals should demonstrate an understanding of the NSN(s) and the general challenges involved in their manufacture. Proposals that fail to demonstrate knowledge of the part will be rejected.
JCP Certification is required to access Government Drawings and Data

PHASE II: Not to exceed - 24 months - $1,000,000
The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation and engineering capability and the availability of appropriate requirements. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.
The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation, engineering and manufacturing capability and the availability of appropriate requirements and funding. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or "Completes" a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

VERSION 2

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.

Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SBM will pursue commercialization of the various technologies and processes developed in prior phases through participation in future DLA procurement actions on items identified but not limited to this BAA.

REFERENCES:

1. DLA Aviation SAR Package instructions. DLA Small Business Resources: http://www.dla.mil/Aviation/Business/IndustryResources/SBO.aspx
2. JCP Certification: https://public.logisticsinformationservice.dla.mil/PublicHome/jcp
3. Access the web address for DIBBS at https://www.dibbs.bsm.dla.mil, then select the "Tech Data" Tab and Log into c-Folders. This requires an additional password. Filter for solicitation "SBIR213C"
4. DLA Small Business Innovation Programs web site: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms
5. DLA Aviation Repair Parts Purchase or Borrow (RPPOB) Program: https://www.dla.mil/Aviation/Offers/Services/AviationEngineering/Engineering/ValueEng.aspx

KEYWORDS: Nuclear Enterprise Support (NESO), Source Approval, Reverse Engineering

VERSION 2

DLA232-002 TITLE: Engaging the Aerospace Bearing Manufacturing Industrial Base in Support of DLA's Critical Supply Chains

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear, Mission Readiness & Disaster Preparedness

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 the Announcement. 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: 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 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 3.5 of the Announcement. 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: Expand the Small Business Manufacturer (SBM) base to address the Agency's need to develop qualified sources of supply for aerospace bearing applictions to improve DLA product availability, provide competition for reduced lead time and cost, as well as address lifecycle performance issues. Through participation in DLA SBIR, SBMs will have an opportunity to collaborate with DLA Weapons System Program Managers (WSPMs) and our customer Engineering Support Activities (ESAs) to develop innovative solutions to DLA's most critical supply chain requirements. In the end, the SBM benefits from the experience by qualifying as a source of supply as well as from the business relationships and experience to further expand their product lines and readiness to fulfill DLA procurement requirements.

DESCRIPTION: : Competitive applicants must have the manufacturing capability to produce ball bearings and roller bearings for aerospace applications along with appropriate quality credentials (AS9100, Nadcap, ISO 9001). We are not looking for engineering firms, distributors, or system integrators. In addition, the manufacturer will have reviewed the parts list provided on DLA Small Business Innovation Program (SBIP) website, (Reference 4) as well as the technical data in the cFolders of DLA DiBBs, (Reference 3). Proposals can evolve in one of four ways depending on the availability of technical data and NSNs for reverse engineering as follows. Information on competitive status, RPPOB, and tech data availability will be provided on the DLA SBIP website, (Reference 4).

a. Fully Competitive (AMC/AMSC-1G) NSNs where a full technical data package is available in cFolders. The SBM proposal should reflect timeline, statement of work and costs associated with the manufacturing and qualification of a representative article.
b. Other than (AMC/AMSC-1G) NSNs where a full Technical Data Package (TDP) is available in cFolders. These items may also require a qualification of a Representative Article. The SBM proposal should reflect timeline, statement of work, and costs associated with producing a Source Approval Request (SAR) and (if applicable) qualification of a Representative Article. Contact the TPOC if necessary. The scope and procedures associated with development of a SAR package are provided in Reference 1.

VERSION 2

c. Repair Parts Purchase or Borrow (RPPOB) or Surplus may be an option for other than 1G NSNs where partial or no technical data is available in cFolders. NSNs, if available, may be procured or borrowed through this program for the purposes of reverse engineering. The instructions for RPPOB can be found on the websites, Reference 5. The SBM proposal should reflect timeline, statement of work and costs associated with the procuring the part and reverse engineering of the NSN. Depending on complexity, producing both the TDP and SAR package may be included in Phase I.
d. Reverse Engineering (RE) without RPPOB or Surplus available is when the NSN will be provided as Government Furnished Material (GFM) if available from the ESA or one of our Service customers post award. In this case, contact the TPOC to discuss the availability of the NSN prior to starting the proposal. Typically, a competitive SBM will have relevant experience in producing a similar item which will enable them to propose without a representative article. The SBM proposal should reflect timeline, statement of work and costs associated with the reverse engineering of the NSN and depending on complexity producing a TDP and SAR package in Phase I.
Specific parts may require minor deviations in the process dependent on the Engineering Support Activity (ESA) preferences and requirements. Those deviations will be addressed post award.

PHASE I: NTE 12 Months $100K. The project schedule should plan to complete the TDP and SAR in the first six months.

The goal of phase I is for the Small Business Manufacturer to qualify as a source of supply for the DLA NSN(s) to improve DLA NSN availability, provide competition for reduced lead time and cost, and address lifecycle performance issues. In this phase, manufacturers will request TDP/SAR approval from the applicable Engineering Support Activity (ESA), as required, for the NSN(s). At the Post Award Conference, the awardee will have the opportunity to collaborate with program, weapon system, and/or engineering experts on the technical execution and statement of work provided in their proposal.
All Phase I Proposals should demonstrate an understanding of the NSN(s) and the general challenges involved in their manufacture. Proposals that fail to demonstrate knowledge of the part will be rejected.
JCP Certification is required to access Government Drawings and Data. Please see reference 2.
PHASE II: The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation, engineering and manufacturing capability and the availability of appropriate requirements and funding. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.

PHASE II: NTE 24 Months $1M.
The Phase II proposal is optional for the Phase I awardee. Phase II selections are based on Phase I performance, Small Business Manufacturer innovation and engineering capability and the availability of appropriate requirements. Typically the goal of Phase II is to expand the number of NSNs and/or to build capability to expand capacity to better fulfill DLA requirements.

Participating small businesses must have an organic manufacturing capability and a Commercial and Government Entity (CAGE) code and be Joint Certification Program (JCP) certified in order to access technical data if available.

Refer to “link 2” below for further information on JCP certification. Additionally, small businesses will need to create a DLA’s Internet Bid Board System (DIBBS) account to view all data and requirements in C Folders.

Refer to “links 3 and 4” below for further information on DIBBS and C Folders. All available documents and drawings are located in the C Folder location “SBIR221A”. If the data is incomplete, or not available, the effort will require reverse engineering.

VERSION 2

PHASE III DUAL USE APPLICATIONS: Phase III is any proposal that "Derives From", "Extends" or "Completes" a transition from a Phase I or II project. Phase III proposals will be accepted after the completion of Phase I and or Phase II projects.

There is no specific funding associated with Phase III, except Phase III is not allowed to use SBIR/STTR coded funding. Any other type of funding is allowed.
Phase III proposal Submission. Phase III proposals are emailed directly to DLA SBIR2@dla.mil. The PMO team will set up evaluations and coordinate the funding and contracting actions depending on the outcome of the evaluations. A Phase III proposal should follow the same format as Phase II for the content, and format. There are, however, no limitations to the amount of funding requested, or the period of performance. All other guidelines apply.

COMMERCIALIZATION: The SBM will pursue commercialization of the various technologies and processes developed in prior phases through participation in future DLA procurement actions on items identified but not limited to this BAA.

REFERENCES:

1. DLA Aviation SAR Package instructions. DLA Small Business Resources: http://www.dla.mil/Aviation/Business/IndustryResources/SBO.aspx
1. JCP Certification: https://public.logisticsinformationservice.dla.mil/PublicHome/jcp
2. Access the web address for DIBBS at https://www.dibbs.bsm.dla.mil, then select the "Tech Data" Tab and Log into c-Folders. This requires an additional password. Filter for solicitation "SBIR213C"
3. DLA Small Business Innovation Programs web site: http://www.dla.mil/SmallBusiness/SmallBusinessInnovationPrograms
4. DLA Aviation Repair Parts Purchase or Borrow (RPPOB) Program: https://www.dla.mil/Aviation/Offers/Services/AviationEngineering/Engineering/ValueEng.aspx

KEYWORDS: Nuclear Enterprise Support (NESO), Source Approval, Reverse Engineering

VERSION 2

DLA232-003 TITLE: Production of Magnesium Metal

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

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 the Announcement. 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: The Defense Logistics Agency (DLA) in an effort to reduce costly foreign reliance and/or single points of failure, is looking for domestic manufacturing of magnesium metal. The end goal of the project would be for the development of a domestic source that would produce industrial quantities of material with a fully domestic or friendly supply chain. New and novel ideas that would allow for competitive pricing with imported magnesium metal and/or novel feedstocks will be preference. Ideally the production process would be modular and scalable.

Research and Development efforts selected under this topic will demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts will be judged to be at a Technology Readiness Level (TRL) six (6) or less, but greater than TRL three (3) to receive funding consideration.

TRL three (3). (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL six (6). (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: The Department Of Defense (DoD) has a need for robust magnesium supply chain to support operational requirements. To this end DLA is looking for domestic production of multiple purity levels of magnesium metal. A desire for the process to use friendly sources of feed materials is preferred but not required. The ideal production process will be both modular and easily scalable.

PHASE I: Phase I will consist of a full process flow including energy usage and waste generation. Then a lab scale process should be used to confirm the estimates and provide preliminary cost and pricing data. A preliminary economic review must be carried out evaluating the cost vs. currently available products as well as determining the cost of production when using North American precursors to the greatest extent practical.

PHASE II: Phase II will consist of making a pilot/ low-rate production plant. Material produced will be characterized for purity. Two (2) sources of raw materials will be identified and tested in this process. Pricing and cost information will be validated. A business case will be generated using both DoD and commercial markets.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in Phase I and Phase II should result in the ability to produce to DoD orders and organic growth of business from there.

REFERENCES:

1. extension://efaidnbmnnnibpcajpcglclefindmkaj/https://us-west-1-02880055-inspect.menlosecurity.com/safeview-

VERSION 2

fileserv/tc_download/bf7b74e726c79549a6b39aad13ee11585e896a95e6eb6074945b155a69852c39/?&cid=N52EB4FF12E53_&rid=949415458ad945b74313f2249875f583&file_url=https%3A%2F%2Fwww.hsdl.org%2Fc%2Fview%3Fdocid%3D764766&type=original

KEYWORDS: advanced materials

VERSION 2

DLA232-004 TITLE: Digital Twin for Cybersecurity of Operational Technology (OT) Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber

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 the Announcement. 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: The Defense Logistics Agency (DLA) is seeking a SBIR Phase I Proof of Concept regarding building a Digital Twin (DT) of a small manufacturing system (OT). By using large sets of "synthetic data" on potential cyberattack vectors allowing DLA to identify cyberattacks in the intrusion detection layer before the attack enters the OT system. The proof of concept should identify the risks and opportunities to counter these attacks. The objective is to define, develop, and create a digital twin that would differentiate the digital signature and anomalies of various cyber-attacks.

DESCRIPTION: As part of DLA's strategic strategy one primary is the focus efforts to ensure the agency's network, systems, and data are protected from emerging and complex cyber threats. 2A significant shift in how operational technologies (OT) are viewed, evaluated, and secured is needed to prevent malicious cyber actors (MCA) from executing successful, and potentially damaging, cyber effects. DLA is working to lead the charge in protecting OT systems from harmful and destructive cyber infiltrations.

DLA's goal is to create a cyber digital twin for OT systems that will increase awareness, and protect against known and unknown vulnerabilities.

PHASE I: The successful proposal should include best-practices, as well as innovative, and novel technologies to depict the physical and digital systems within a specific OT environment. This Phase of the project should be:

1. Manage continual input from the physical system to the Digital Twin (DT). Ideally to look for a low cost and automated data flow using AWS/GCP cloud infrastructure.
2. The protection of digital signatures and inferences imbedded in the algorithms from cyberattacks.
3. Scale the algorithm for other OT systems.
4. Verify the performance of the digital twin through correlation between its predictions and the physical system events for given initial and progressing conditions. If a combination of synthetic and real data is used, what are the controllable parameters to calibrate the digital twin models and the corresponding machine learning models to use their predictions and drive actions on real-world system?

PHASE II: Develop a prototype for the process(es) proven in Phase I that can be transferred to a DLA production environment.

1. Refine the Transition Plan.
2. At the completion of this Phase II project, the Technology Readiness Level (TRL) should be TRL 3-6.

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in PHASE I and PHASE II should result in a functional product that could transition into other areas.

VERSION 2

COMMERCIALIZATION: The partners identified in the Phase II transition plan should be aware of as well as involved in the project and have a plan to incorporate the project into their program of record, or commercial portfolio.

REFERENCES:

1. Source: extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.dla.mil/Portals/104/Documents/Headquarters/StrategicPlan/DLAStrategicPlan2021-2026.pdf
2. Source: extension://efaidnbmnnnibpcajpcglclefindmkaj/https://media.defense.gov/2021/Apr/29/2002630479/-1/-1/1/CSA_STOP-MCA-AGAINST-OT_UOO13672321.PDF

KEYWORDS: Digital twin, operational technology, cybersecurity, cyberattack, synthetic data.

VERSION 2

DLA232-005 TITLE: SBIR Phase 1: Feasibility Study of an Automated Inventory Technology for the Defense Logistics Agency (DLA), Distribution Centers (DCs)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Infrastructure & Advanced Manufacturing, Sustainment & Logistics

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 the Announcement. 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: The objective of this SBIR Solicitation is to support the discovery (through market research), identification (through innovation outreach), research (through feasibility studies), development (through prototyping), test (through experimental, developmental, and operational testing), evaluation (through clear metrics), and maturation (through technology readiness assessments) of existing leading-edge commercial industry 4.0 technologies (also depicted in figure 1):

- Autonomous Robots
- Modeling and Simulation
- System Integration
- Internet of Things (IoT)
- Cybersecurity Controls
- Cloud Computing
- Augmented Reality
- Artificial Intelligence (AI) and Predictive Analytics

Commercial industry 4.0 technologies will directly influence the agency's DCs from existing inefficient operations into modern 21st-century Smart-warehouses wherever practicable. Best business practice elements from DoDI 5000.80 – MTA will be incorporated wherever possible to support the prototyping activities. Existing commercial industry 4.0 technologies have already been implemented in the manufacturing industry to increase efficiencies in the manufacturing floor. In addition, existing commercial industry 4.0 technologies have been implemented in warehouses to increase mass efficiencies, for instance, Amazon has developed its smart-warehouses with robust focus on industry 4.0 technologies to increase efficiencies in Amazon's warehouses to meet the need of its customers.

Problem statement:
Inventory Management - Inventory management practices and procedures are inefficient, consuming significant resources. DLA Distribution incurs continuous Business risks due to maintaining high levels of inventory that exceed requirements and weaknesses in inventory accuracy. Currently, DLA DCs have a requirement of 100% inventory reconciliation and verification to account for every single item stored in the warehouses, and to ensure every physical item stored match the stock record. The current process of inventory reconciliation is labor intensive, it takes long lead times to process, and it leads to inaccuracies of data (due to human error). The impact of this problem is seen in the current increase of labor hours, long lead times, and the increase of operational and labor cost of every DCs.

Concept statement:
DLA DCs lack automation in comparison to the private sector, as result this creates inefficiencies in warehouse operations. Currently, warehouse operations consume abundant amount of resources, i.e., time,

human labor, paper, documentation, cost, data error, misplacement of material, bottle necks, etc. Most of current DLA Distribution systems are approximately 20 years old to include the Distribution Standard System (DSS) and the Equipment Control System (ECS) that obtained Full Operational Capability (IOC) in 1999. Many of the current warehouse systems are unsustainable, inefficient, and present many cybersecurity challenges. It is important to state that legacy systems were not designed with cybersecurity considerations, with DLAs mission changing over the past 20 years, and cyber threats are now on the forefront. It is critical to DLA Distribution to replace legacy system with state-of-the-art technology/systems that are designed with cybersecurity considerations, and evaluated through Research, Development, Test and Evaluation (RDT&E) activities.

DESCRIPTION: The execution of this SBIR effort will require a strong partnership between technology managers of DLA Information Operations (J6), and distribution managers at DLA Distribution (J4) to identify, research, develop, test, evaluate, and determine the feasibility, and maturity of smart-warehouse commercially available industry 4.0 technologies to seamlessly integrate within the DLA's network, the warehouse management system (WMS), and the warehouse execution system (WES). Note: Integration with the WMS/WES cannot occur until at a minimum TRL 7-9. This will be a Phase II requirement. Offerors should state the TRL on their proposals.

Existing commercially available industry 4.0 technologies determined as feasible with an overall "value proposition" will then be recommended for transition and fielding into the DLA distribution operational environment throughout the DLA enterprise of DCs. It is acknowledged that some commercially available industry 4.0 technologies may not provide a return on investment (ROI) or "value proposition" throughout the DLA enterprise of DCs due to mission operational tempo and location. Nevertheless, transforming DLA's DCs into smart warehouses is anticipated to gain efficacies whenever possible via automation for labor-intensive warehouse tasks, thereby creating warehouse operations that are more cost-effective and efficient. Additionally, this DMP R&D Charter envisions upon completion of rigorous prototyping, test, and evaluation of existing commercially available industry 4.0 Technologies, such as autonomous robots, modeling, and simulation, system integration tools, IoT, cloud computing, augmented reality, and artificial intelligence for predictive analytics with significantly improved cybersecurity controls. Figure 2 depicts DLA's Traditional Warehouse (current state) versus DLA's 5G Smart-warehouses (future state).

TRLs are the most common measure for communicating the readiness of new technologies or new applications of existing technologies to be incorporated into a system or program and describe the increasing levels of technical maturity based on demonstrated (tested) capabilities based on demonstrations of increasing fidelity and complexity measured on a 1-9 scale, where level 1 generally represents paper studies of the basic concept, moving to laboratory demonstrations around level 4, and ending at level 9, where the technology is tested and proven, integrated into a product.

PHASE I: Feasibility Study – Not to exceed 6 months
This phase encompasses only requirement analysis with no prototype development. This phase entails:

- Identification of Capability Gaps: Offeror(s) will collaborate with the DLA Distribution Stakeholders to identify capability gaps within the current DLA distribution environment and how these gaps can be closed by implementing Smart-warehouse technologies. The capability gap analysis must identify the problem statement(s) as defined by DLA stakeholders, describe the current "As-Is" problems, and define an acceptable redesigned capability by identifying the changes required to generate the desired "To-Be" capability to eliminate the capability gaps.
- Requirements Analysis: Offerors will identify the tasks required and conditions needed to meet DLA's needs using new or modified technologies, consider the possibility of conflicting requirements,

and analyze, document, validate, and manage software or system requirements. This analysis is critical to the success or failure of the Smart-warehouse concept; it must be documented, actionable, measurable, testable, traceable, related to DLA's identified business needs or opportunities, and defined to a level of detail sufficient for the system design.

- End-User Requirements: Offerors will identify the tasks the end-user(s) need to be able to carry out to successfully perform their jobs and optimize the processes required for Smart-warehouses.
- Concept of Operations (CONOPS): The offeror must create a CONOPS for a Smart-warehouse concept that supports both routine and wartime distribution warehouse operations. The concept of operations covers utilizing Smart-warehouse technologies within DLA distribution warehouses during routine operations (e.g., Department of Defense (DoD) Enterprise Architecture; OV-1, etc.).
- Functional Requirements: Offerors must define the functions of the Smart-warehouse and describe the functional inputs and outputs of the Smart-warehouse. (Any inputs that are unattainable should be documented and assigned a corresponding risk that details the effect on the project). These requirements may involve calculations, technical details, data manipulation and processing, and other functionality that defines what the Smart-warehouse is supposed to accomplish; these requirements are captured in use cases.
- System Requirements: Offeror(s) must identify the functionality needed by a system to satisfy the DLA Distribution customer's requirements. The selected offeror(s) must determine the system requirements that most effectively meet the end user's needs.
- Preliminary Metrics: Identify Key Performance Parameters (KPPs), Key Performance Indicators (KPIs), Key Systems Attributes (KSAs), and other relevant operational metrics.
- Technology Readiness Assessments (TRAs) as required: Identify TRL and validated by the government. Assess and demonstrate the Smart-warehouse technology prototype(s) are capable of technology maturity (TRL 4 -9) of Technology Readiness.

PHASE II: Prototype Development, T&E - Not to exceed 24 Months
After completing Phase 1, and based upon what they learn from Phase 1, a proposal for Phase II can be submitted. This phase encompasses prototype development, T&E for technology maturation including:

- Prototype Development: Using elements from Phase I and addressing DLA Distribution defined user requirements, functional requirements, and system requirements a prototype (s) is developed for Experimentation, Developmental Test and Evaluation (DT&E), Early Operational Assessment (EOA), and Initial Operational Test and Evaluation (IOT&E).
- Experimentation, DT&E, EOA, IOT&E: Using Government designated testing location/environment, conduct test and evaluation, integration as feasible with the DLA Warehouse Execution System (WES) and/or implement government cybersecurity controls with the Smart-warehouse prototype(s) to demonstrate functionality within the Operational Environment (OE) for cybersecurity certification. T&E against the preliminary metrics identified in Phase 1 (KPPs, KSIs, KSAs and operational requirements) and refined the metrics as required.
- Technology Readiness Assessments (TRAs): Assess and demonstrate the Smart-warehouse prototype(s) are capable of technology maturity (TRL 4-7) of Technology Readiness throughout Phase 2 and achieve Level (TRL) 7- 9 upon completion of Phase 2 for transition. Note that integration with DLA's WMS and WES cannot occur until at a minimum TRL 7-9.

PHASE III DUAL USE APPLICATIONS: Dual Use Applications: At this point, there is no specific funding associated with Phase III. During Phase I and Phase II, the progress made should result in a vendor's qualification as an approved source for a Warehouse Inventory Management system and support participation in future procurements.

COMMERCIALIZATION: The manufacturer will pursue the commercialization of the Warehouse Inventory Management technologies and designs developed to apply to the warehouse environment -- the processes developed in preliminary phases and potential commercial sales of manufactured mechanical parts or other items. The first path for commercial use is at DLA's twenty-four Distribution Centers and twenty Disposition Centers. When fielded, DLA estimates 20 - 24 units, but the number of units could be more.

REFERENCES:

1. Buffi, A., Tellini, B., "A Novel Phase-based Method for UHF-RFID Tag Localization via UAV", 2019 IEEE 5th International forum on Research and Technology for Society and Industry (RTSI), pp.370-375, 2019.
2. Gope, P., Millwood, O., Saxena, N., “A provably secure authentication scheme for RFID-enabled UAV applications”, Computer Communications, Volume 166, 2021, Pages 19-25, ISSN 0140-3664, https://doi.org/10.1016/j.comcom.2020.11.009
3. Greco, G.; Lucianaz, C., Bertoldo, S., Allegretti, M., “Localization of RFID tags for environmental monitoring using UAV”, Electronico (2015), pp. 480-483, DOI:10.1109/RTSI.2015.7325144
4. Jasrotia, D., Manisha J. Nene, "Localisation using UAV in RFID and Sensor Network Environment: Needs and Challenges", 2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), pp.274-279, 2019.
5. Kachroo, A., Vishwakarma, S., Dixon, J.N, Abuella, H., Popuri, A., Abbasi, Q.H., Bunting, C.F., Jacob, J.D., Ekin, S., "Unmanned Aerial Vehicle-to-Wearables (UAV2W) Indoor Radio Propagation Channel Measurements and Modeling", IEEE Access, vol.7, pp.73741-73750, 2019.
6. Karan, E., Christmann, C., Gheisari, M., Irizarry, J. and Johnson, E. (2014). A Comprehensive Matrix of Unmanned Aerial Systems Requirements for Potential Applications within a Department of Transportation Construction Research Congress 2014 American Society of Civil Engineers 0 964-973 A.
7. Quino, J., Maja, J.M., Robbins, J., Fernandez, R.T., Owen, Jr., J.S., Chappell, M., “RFID and Drones: The Next Generation of Plant Inventory”, AgriEngineering 2021, 3, 168-181. https://doi.org/10.3390/agriengineering3020011

KEYWORDS: Drone, Warehouse Inventory Management, Warehouse, Distribution, Inventory, Inventory Management, Logistics, Simulation, Modeling and Simulation, Sustainment, Availability, Reliability, Maintainability, Supportability, Software Development, Machine Learning, Neural Networks, Real-time Computational Intelligence, Data Science, Software Architecture, Deep Learning.

VERSION 2

DLA232-006 TITLE: Innovation in Thermodynamics of Fractional Separation of Multi-component Mixtures (E-waste) for Strengthening our Supply Chain

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

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 the Announcement. 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: 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 the Announcement. 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: The Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies of related materials consistently to our Department of Defense (DoD) customers and other DoD stakeholders. DLA continually investigates diverse technologies for new or improved materials, more efficient means of their production, and more competitive domestic supply chains which would lead to higher levels of innovation in current and future weapon systems combined with benefits to other commercial and government technology applications.

Advanced technology demonstrations for increasing production capacity, affordability and supply chain resiliency for critical materials and processing are of high interest to DoD. These areas of materials and manufacturing technology provide potential opportunities toward achieving breakthrough advances for national defense. Proposed efforts funded under this topic may encompass diverse materials and processing at any level that will result in increasing production capacity, affordablity, and supply chain resiliency.

Research and Development (R&D) efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology and/or Manufacturing Readiness Level (TRL/MRL) 6 or less, but greater than TRL/MRL 3 to receive funding consideration.
TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: DLA R&D is looking for domestic capabilities and capacity to recover strategic materials from e-waste via novel recovery techniques that increase the domestic availability of technology for supply chain resiliency of strategic materials.

R&D tasks include identifying, developing, and demonstrating new and/or improved fundamental scientific understanding and the recovery of critical materials in small volume fraction in a multi-component mixture. E-waste presents a strategic opportunity to receover critical elements currently in the economy as end of life hardware, but we are faced with a limited fundamental understanding of extracting numerous low-volume fraction components with sufficient purity and yield. Related areas of interest include development of software tools that builds up on existing open-source and commercially available databases for fractional separation of multi-component mixtures.

PHASE I: Not to exceed a duration of 6 months and cost of $100,000
Chemical separation of multi-component mixtures such as e-waste is achieved by exploiting the energy and enthalpy landscape of the components. Fractional separation builds upon this fundamental understanding by exploiting the difference in energy levels needed to uniquely separate two or more components in the mixture. In the case of e-waste, this fundamental knowledge is lacking, and this program aims to address this need through advanced mathematical modeling (e.g., relative thermodynamic stability of multi-component mixtures, corrosion models, mechanical degradation models, etc.,), and apply this fundamental knowledge for fractional recovery of critical elements from e-waste. Collboartion with a relavant DoD Component organzation (e.g., DoD lab and/or defense system program office) and one or more relavant DoD weapon system supply chain participants or other suitable organization is highly desirable.

The ultimate goal of this program is to develop the mathematical models into a software package that can inform process control for recycling by the broader industry community to convert a plurality of feedstock into raw mateirals for manufacturing.

PHASE II: Not to exceed a duration of 18 months and cost of $1,800,000.
- Develop and mature the software package for critical materials recovery from a commercial e-waste feedstock (phones, tablets, cameras, other communication hardware).
- Develop applicable and feasible software modules with appropriate GUI and HCI to demonstrate the fractional recovery of critical elements from e-waste in a virtual environment
- Develop a technoeconomic analysis software that combines recovery technology and prevalent market conditions that can inform an end-user (recyclers).
- Performers should identify methods to validate the feasibility of their approach innovation for DLA and key DoD stakeholders, and outline their validation strategy in the proposal. Validation would include, but is not limited to, prototype quantities, data analysis, laboratory tests, system simulations, operation in test-beds, or operation in a demonstration system. Collboartion with a relavant DoD Component organzation (e.g., DoD lab and/or defense system program office) and one or more relavant DoD weapon system supply chain participants or other suitable organization is highly desirable. Identify commercial benefit or application opportunities of the innovation. Innovative processes should be developed with the intent to readily transition to production in support of DoD and its supply chains.

PHASE III DUAL USE APPLICATIONS: Expand the scope of this software package for refining by mining and processing industry.

REFERENCES:
1. Coates, G. and Rahimifard, S. (2009). Modelling of Post Fragmentation Waste Stream Processing withing UK Shredder Facilities. Waste Management
2. Schaik, A and Reuter, M. (2010) Dynamic Modelling of E-Waste Recycling System Performance Based on Product Design. Minerals Engineering
3. T. Gutowski (2008) Thermodynamics & Recycling, A Review. IEEE International Symposium on Electronics & the Environment

KEYWORDS: e-waste, critical materials, recycler, thermodynamics, separation

VERSION 2

DLA232-D07 TITLE: Direct to Phase II - Verifying Domestic Sourced or Manufactured Nodular Aluminum (Al) Powder Can Meet Military Requirements

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Advanced Materials

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 the Announcement. 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: The Defense Logistics Agency (DLA) seeks to provide responsive, best value supplies consistently to our customers. DLA continually investigates diverse technologies for manufacturing which would lead to the highest level of innovation in the discrete-parts support of fielded weapon systems (many of which were designed in the 1960's, 1970's and 1980's) with a future impact on both commercial technology and government applications. As such, advanced technology demonstrations for affordability and advanced industrial practices to demonstrate the combination of improved discrete-parts manufacturing and improved business methods are of interest. All these areas of manufacturing technologies provide potential avenues toward achieving breakthrough advances. Proposed efforts funded under this topic may encompass any specific discrete-parts or materials manufacturing or processing technology at any level resulting in a unit cost reduction.

Research and Development efforts selected under this topic shall demonstrate and involve a degree of risk where the technical feasibility of the proposed work has not been fully established. Further, proposed efforts must be judged to be at a Technology Readiness Level (TRL) 6 or less, but greater than TRL 3 to receive funding consideration.
TRL 3. (Analytical and Experimental Critical Function and/or Characteristic Proof of Concept)
TRL 6. (System/Subsystem Model or Prototype Demonstration in a Relevant Environment)

DESCRIPTION: DLA R&D is looking to develop domestic capability to create a qualified Nodular Aluminum Powder and the availability of material supply for use at McAlester Army Ammunition Plant (MCAAP) and Joint Munitions Command (JMC). Nodular Aluminum Powder is widely used in a number of munition systems. Nodular Aluminum Powder is also known as atomized aluminum powder and has unique properties will allow it to adequately raise the reaction temperature of a detonation due to its low sensitivity and good mechanical properties. The purpose of this work is to establish an economically viable and qualified domestic source of Nodular Aluminum Powder.
R&D tasks include qualifying domestically manufactured or sourced powder by working with MCAAP and JMC to meet their militrary requirements.

PHASE I: To satisfy the Phase I requirement, please Provide a Proof of Concept developed to the TRL-3 Level

PHASE II: Direct to PHASE II: – 12 Months $1,500,000
Design, optimize, manufacture and qualify Nodular Aluminum Powder to be used for military applications specifcally for MCAAP and JMC. Qualifaction would include, but is not limited to, prototype quantities, data analysis and laboratory tests. Optimization would determine the ideal manufacturing processees that can meet desired property specifications used in military applications. Qualified designs would meet property specifications used in military applications.

VERSION 2

PHASE III DUAL USE APPLICATIONS: At this point, no specific funding is associated with Phase III. Progress made in Phase I and Phase II should result in the ability to produce to DoD orders and organic growth of business from there.

REFERENCES:

1. extension://efaidnbmnnnibpcajpcglclefindmkaj/https://us-west-1-02880055-inspect.menlosecurity.com/safeview-fileserv/tc_download/bf7b74e726c79549a6b39aad13ee11585e896a95e6eb6074945b155a69852c39/?&cid=N52EB4FF12E53_&rid=949415458ad945b74313f2249875f583&file_url=https%3A%2F%2Fwww.hsdl.org%2Fc%2Fview%3Fdocid%3D764766&type=original

KEYWORDS: advanced materials

VERSION 3

Defense Threat Reduction Agency (DTRA)
Small Business Innovation Research (SBIR) 23.2
Proposal Submission Instructions

INTRODUCTION
The Defense Threat Reduction Agency (DTRA) mission is to enable the DoD, the U.S. Government, and International Partners to counter and deter Weapons of Mass Destruction (WMD) Chemical Biological, Radiological, Nuclear) and Improvised Threat Networks. The DTRA SBIR program is consistent with the purpose of the Federal SBIR/STTR Program, i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns and through Federal-funded research or research and development (R/R&D).

The approved FY23.2 topics solicited for the Defense Threat Reduction Agency (DTRA) Small Business Innovation Research (SBIR) Program are included in these instructions followed by the full topic description. Offerors responding to this Broad Agency Announcement (BAA) must follow all general instructions provided in the related Department of Defense Program BAA and submit proposals by the date and time listed in the DoD Program BAA. Specific DTRA requirements that add to or deviate from the DoD Program BAA instructions are provided below with references to the appropriate section of the DoD document.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

The DTRA Small Business Innovation Research (SBIR) Program is implemented, administered, and managed by the DTRA SBIR/STTR Program Office. Specific questions pertaining to the administration of the DTRA SBIR Program and these proposal preparation instructions should be submitted to:

Mr. Mark D. Flohr
DTRA SBIR/STTR Program Manager
Mark.D.Flohr.civ@mail.mil
Tel: (571) 616-6066

Defense Threat Reduction Agency
8725 John J. Kingman Road
Stop 6201
Ft. Belvoir, VA 22060-6201

For technical questions about specific topic requirements during the pre-release period, contact the DTRA Technical Point of Contact (TPOC) for that specific topic. To obtain answers to technical questions during the formal BAA open period, visit: https://www.dodsbirsttr.mil/submissions/login. For questions regarding the Defense SBIR/STTR Innovation Portal, contact DSIP Support at dodsbirsupport@reisystems.com.

Proposals not conforming to the terms of this announcement will not be considered. DTRA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality as determined by DTRA will be funded. DTRA reserves the right to withdraw from negotiations at any time prior to contract award. The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

VERSION 3

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA. DTRA requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 20 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages in the technical volume over 20 pages will not be considering in proposal evaluations.

Content of the Technical Volume

The Technical Volume should cover the following items <u>in the order given below</u>:

(a) Identification and Significance of the Problem or Opportunity.
Define the specific technical problem or opportunity addressed and its importance.

(b) Phase I Technical Objectives.
Enumerate the specific objectives of the Phase I work, including the questions the research and development effort will try to answer to determine the feasibility of the proposed approach.

(c) Phase I Statement of Work (including Subcontractors' Efforts)

(1) Provide an explicit, detailed description of the Phase I approach. The Statement of Work should indicate what tasks are planned, how and where the work will be conducted, a schedule of major events, and the final product(s) to be delivered. The Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the Technical Volume section.

(2) This BAA may contain topics that have been identified by the Program Manager as research or activities involving Human/Animal Subjects and/or Recombinant DNA. In the event that Phase I performance includes performance of these kinds of research or activities, please identify the applicable protocols and how those protocols will be followed during Phase I. Please note that funds cannot be released or used on any portion of the project involving human/animal subjects or recombinant DNA research or activities until all of the proper approvals have been obtained. **Submitters proposing research involving human and/or animal use are encouraged to separate these tasks in the technical proposal and cost proposal in order to avoid potential delay of contract award.**

(d) Related Work.
Describe significant activities directly related to the proposed effort, including any

conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The technical volume must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following:

(1) Short description,
(2) Client for which work was performed (including individual to be contacted and phone number), and
(3) Date of completion.

(e) Relationship with Future Research or Research and Development

(1) State the anticipated results of the proposed approach if the project is successful.
(2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research or research and development effort.
(3) Identify the applicable clearances, certifications and approvals required to conduct Phase II testing and outline the plan for ensuring timely completion of said authorizations in support of Phase II research or research and development effort.

(f) Commercialization Strategy. Describe in approximately one page your company's strategy for commercializing this technology in DoD (such as a formal DoD Program), other Federal Agencies, and/or private sector markets. Provide specific information on the market need the technology will address and the size of the market. Also include a schedule showing the quantitative commercialization results from this SBIR project that your company expects to achieve.

(g) Key Personnel. Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise technical resume of the principal investigator, including a list of relevant publications (if any), must be included (Please do not include Privacy Act Information). All resumes will count toward the page limitations for Volume 2.

(h) Foreign Citizens. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Proposers frequently assume that individuals with dual citizenship or a work permit will be permitted to work on an SBIR project and do not report them. This is not necessarily the case and a proposal will be rejected if the requested information is not provided. Therefore, firms should report any and all individuals expected to be involved on this project that are considered a foreign national as defined in the BAA. You may be asked to provide additional information (e.g., copy of valid passport, visa, work permit, etc.) during negotiations in order to verify the foreign citizen's eligibility to participate on a SBIR contract. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

VERSION 3

(i) Facilities/Equipment. Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Justify equipment purchases in this section and include detailed pricing information in the Cost Volume. State whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name), and local Governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

(j) Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described to the same level of detail as the prime contractor costs. A minimum of two-thirds (66%) of the research and/or analytical work in Phase I, as measured by direct and indirect costs, must be conducted by the proposing firm, unless otherwise approved in writing by the Contracting Officer. For Phase II, a minimum of one-half (50%) of the research and/or analytical work must be performed by the proposing firm. The percentage of work is measured by both direct and indirect costs. SBIR efforts may include subcontracts with Federal Laboratories and Federally Funded Research and Development Centers (FFRDCs). A waiver is no longer required for the use of federal laboratories and FFRDCs; however, proposer must certify their use of such facilities on the Cover Sheet of the proposal.

For both Phase I and II, the primary employment of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Primary employment with a small business concern precludes full-time employment at another organization.

(k) Prior, Current, or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this BAA is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information. Refer to the instructions provided in the DoD STTR BAA for this requirement.
Note: If this does not apply, state in the proposal "No prior, current, or pending support for Proposed work"

Cost Volume (Volume 3)
The Phase I Base amount must not exceed $167,500. For the Cost Volume, DTRA requires the use of a Microsoft excel spread sheet which is available on the DSIP portal.

Important: when completing the cost volume, enough information should be provided to allow the agency to understand how you plan to use the requested funds if a contract is awarded. Itemized costs of any subcontract or consultant should be provided to the same level as for the prime small business. If an unsanitized version of costs cannot be provided with the proposal, the Government may request it during negotiations if selected. Refer to the instruction provided in the DoD SBIR program BAA for additional details on the content of the Cost Volume.

Note: Cost for travel funds must be justified and related to the needs of the project. DTRA does not include any fee on travel costs, so proposal should exclude fee on any travel costs proposed.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. DTRA will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

For more information about cost proposals and accounting standards, see https://www.dcaa.mil/Guidance/Audit- Process-Overview/.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DTRA during proposal evaluations.

Supporting Documents (Volume 5)
Volume 5 is provided for proposers to submit additional documentation to support the Coversheet (Volume 1), Technical Volume (Volume 2), and the Cost Volume (Volume 3). Please refer to the DoD Program BAA for details on required Supporting Documents.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees.
The Phase II proposals are best submitted no later than (NLT) 30 days AFTER the end of the 7 month Phase I period of performance.

All SBIR Phase II awards made on topics from solicitations prior to FY13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

DTRA has established a **40-page limitation** for the Technical Volume for Phase II proposals. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), or the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments.

Further details on the due date, content, and submission requirements of the Phase II proposal will be provided either in the Phase I award or by subsequent notification.

Phase II Proposal Instructions
Each Phase II proposal must be submitted through the Defense SBIR/STTR Innovation Portal (DSIP) by the deadline as specified in the Phase II Proposal Guidelines, or in the Phase I award or subsequent notification. **The format should be similar to Phase I proposal except the Phase II Technical Proposal is limited to 40 pages.** Each proposal submission must contain a Proposal Cover Sheet, Technical Volume, Cost Volume, a Company Commercialization Report (see the appropriate section of the DoD Program BAA) and Volume 5. The Commercialization Strategy section of the technical proposal should be more specific than was required for Phase I. Refer to the DoD Program BAA for additional details.

Phase II Evaluation Criteria

Phase II proposals will be reviewed for overall merit based upon the criteria specified in the DoD Program BAA and will be similar to the Phase I process.

Public Release of Award Information

If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit https://www.dodsbirsttr.mil/submissions/login.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I or Phase II SBIR award to purchase Discretionary Technical & Business Assistance services, such as access to a network of scientists and engineers engaged in a wide range of technologies, or access to technical and business literature available through on-line data bases, for the purpose of assisting such concerns as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects;
- developing/ commercializing new commercial products/processes resulting from such projects; and,
- meeting cyber security requirements.

If you are proposing use of Discretionary Technical and Business Assistance (TABA), you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the Technical and Business Assistance you will receive. For the Phase I project, the amount for TABA may not exceed $6,500 per award. For the Phase II project, the TABA amount may be less than, equal to, but not more than $50,000 per project. The description should be included in Volume 5 of the proposal.

Approval of Discretionary Technical and Business Assistance is not guaranteed and is subject to review of the contracting officer.

For Discretionary Technical and Business Assistance, small business concerns may propose one or more vendors. Additionally, business-related services aimed at improving the commercialization success of a small business concern may be obtained from an entity, such as a public or private organization or an agency or other entity established or funded by a State that facilitates or accelerates the commercialization of technologies or assists in the creation and growth of private enterprises that are commercializing technology.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA. DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Notifications
Following the EA decision, the DTRA SBIR/STTR office will release notification e-mails of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official. Offerors may request a debriefing of the evaluation of their not-selected proposal and should submit this request via email to: dtra.belvoir.RD.mbx.sbir@mail.mil and include "SBIR 23.2 / Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or without opportunity for revision for proposals that are reasonable and complete.

DTRA Support Contractors
Select DTRA-employed support contractors may have access to contractor information, technical data or computer software that may be marked as proprietary or otherwise marked with restrictive legends. Each DTRA support contractor performs under a contract that contains organizational conflict of interest provisions and/or includes contractual requirements for nondisclosure of proprietary contractor information or data/software marked with restrictive legends. These contractors require access while providing DTRA such support as advisory and assistance services, contract specialist support, and support of the Defense Threat Reduction Information Analysis Center (DTRIAC). The contractor, by submitting a proposal or entering into this contract, is deemed to have consented to the disclosure of its information to DTRA's support contractors.

The following are, at present, the prime contractors anticipated to access such documentation: Broadleaf Inc (contract specialist support), Kent, Campa and Kate, Inc. (contract closeout support), ARServices (Program Management Advisory and Assistance Services--A&AS), Systems Planning and Analysis, Inc. (Subject Matter Expertise A&AS), Polaris Consulting (Small Business Program Support), Seventh Sense Consulting, LLC (Acquisition Support), Kapili Services, LLC and TekSynap (DTRIAC) and Savantage Solutions (Accounting and Financial Systems Support). This list is not all inclusive (e.g., subcontractors) and is subject to change.

Protests
Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to:

"Service of Protest (Sept 2006)
(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the Government Accountability Office (GAO), shall be served on the Contracting Officer (addressed to Mr. Herbert Thompson, Contracting Officer, as follows) by obtaining written and dated acknowledgment of receipt from (if mailed letter) Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 1680 Texas Street, Kirtland

AFB, NM 87117. If Federal Express is used for the transmittal, the appropriate address is: Defense Threat Reduction Agency, ATTN: AL-ACQ (Mr. Herbert Thompson), 8151 Griffin Avenue SE, Building 20414, Kirtland AFB, NM 87117-5669.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.
(End of provision)"

AWARD AND CONTRACT INFORMATION
DTRA plans on Phase I projects for a seven (7) month period of performance with six months devoted to the research and the final month for the final report. The award size of the Phase I contract is no more than $167,500.00, notwithstanding a maximum of $6,500.00 for Discretionary Technical and Business Allowance (TABA). For a Phase II project, DTRA plans on a 24 month period of performance. The award size of a Phase II contract is no more than $1,100,000.00, notwithstanding a maximum of $50,000.00 for TABA for the entire project.

ADDITIONAL INFORMATION

Export Control Restrictions

The International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, will apply to all projects with military or dual-use applications that develop beyond fundamental research, which is basic and applied research ordinarily published and shared broadly within the scientific community. More information is available at https://www.pmddtc.state.gov/ddtc_public.

The technology within some DTRA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of listed defense-related material, technical data and services that provide the United States with a critical military advantage. EAR controls military, dual-use and commercial items not listed on the United States Munitions List or any other export control lists. EAR regulates export-controlled items based on user, country, and purpose. **The offeror must ensure that their firm complies with all applicable export control regulations.**

NOTE: Export control compliance statements found in these proposal instructions are not meant to be all inclusive. They do not remove any liability from the submitter to comply with applicable ITAR or EAR export control restrictions or from informing the Government of any potential export restriction as fundamental research and development efforts proceed.

Cyber Security
Any Small Business Concern receiving an SBIR award is required to provide adequate security on all covered contractor information systems. Specific security requirements are listed in DFARS 252.204.7012, and compliance is mandatory.

Feedback
In an effort to encourage participation in, and improve the overall SBIR award process, offerors may submit feedback on the SBIR solicitation and award process to: dtra.belvoir.RD.mbx.sbir@mail.mil for consideration for future SBIR BAAs.

VERSION 3

DTRA SBIR 23.2 Phase I Topic Index

VERSION 3

DTRA232-001 TITLE: Computational Modeling of Human Blast Injuries in the Battle Fields

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Combat Casulty care; Biotechnology

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 the Announcement. 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: To develop a computational modeling tool to simulate human blast injuries in the battle field

DESCRIPTION: In the battle fields, more than 90% of the injuries are caused by blasts. The physiology and pathology of blast injuries have been thoroughly studied. Human data for blast injuries is available and ready to use. However, there is no computational modeling tool to simulate the potential injuries. US Army Research laboratory at DEVCOM has developed a tool called "Operational Requirements-based Casualty Assessment (ORCA) Model" but it is not operational. The Defense Science and Technology Laboratories (Dstl) in UK also developed a tool called human injury predictor (HIP) but it is too simple to be applied to predict comprehensive injuries in the battle fields. In DTRA Reachback, we have received numerous requests from COCOMs to model the blast injuries in different scenarios. Because of the limitation of our current capability, we are not able to answer the questions and constantly disappoint the customers. It is therefore, urgent to develop a modeling tool or system to predict the blast injuries in order to support the warfighters. NATO has established a group to push this effort but the funding from NATO is very limited. We would like to make this proposal to send a signal to the acquisition community to be aware of this urgent request.

PHASE I: Phase I will focus on the model framework formation. Offerors should be able to understand the types of weapons, principle of the blasts, basic knowledge of human physiology and anatomy. Battle field or weapon testing experience is preferred. By the end of phase I, a GUI and premodel should be created and ready for next-step development. All the challenges should be clearly recorded in this phase in order to find solutions in the phase II.

PHASE II: Phase II will finish the construction work of the model. Data analysis, data input, testing and validation will be the major tasks in phase II. By the end of phase II, offerors should provide a package or system for the customers to use. The GUI will be further modified based on the end-user requests. The output should be validated by testing data and publication. The developer should work closely with DTRA Reachback personnel to test the system. Meanwhile, the developer should invite Command Surgeons and other medical staff to review the model to make sure that the model meets the military operational requirements.

PHASE III DUAL USE APPLICATIONS: In phase III, the offeror should refine the model based on the feedback from the Command Surgeons and other customers. The data need to be updated according to the newest research. Maintenance and update will be performed in phase III.

VERSION 3

REFERENCES:

1. Physics and Physiology Based Human Body Model of Blast Injury and Protection.https://www.sbir.gov/content/physics-and-physiology-based-human-body-model-blast-injury-and-protection-0;
2. A Human Body Model for Computational Assessment of Blast Injury and Protection.https://www.sbir.gov/node/401733;
3. Experimental platforms to study blast injury. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6581094/;
4. SIMULATING TRAUMATIC BRAIN INJURY IN VITRO: DEVELOPING HIGH THROUGHPUT MODELS TO TEST BIOMATERIAL BASED THERAPIES. https://blastinjuryresearch.health.mil/;
5. Simulation of blast lung injury induced by shock waves of five distances based on finite element modeling of a three-dimensional rat. https://www.nature.com/articles/s41598-019-40176-7;
6. Localizing Clinical Patterns of Blast Traumatic Brain Injury Through Computational Modeling and Simulation. https://www.frontiersin.org/articles/10.3389/fneur.2021.547655/full;
7. Computational modeling of human head under blast in confined and open spaces: primary blast injury. https://onlinelibrary.wiley.com/doi/full/10.1002/cnm.2590;
8. DOD-Funded Researcher Studies the Impact of Primary Blast Injuries on the Eye. https://www.eyeresearch.org/events/AEVR_Defense_Briefing_2013;
9. Numerical Simulation of Primary Blast Brain Injury. https://dukespace.lib.duke.edu/dspace/handle/10161/6148;
10. Protecting Warfighters from Blast Injury.https://www.cnas.org/publications/reports/protecting-warfighters-from-blast-injury;
11. Multi-scale Modeling of Trauma Injury. https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A15f1662eabca807aa7063ed8351d624a6a3d835f7bdc24b841041cf7ee177d522;
12. Building and validating a model of human blast traumatic brain injury: a hybrid computational and experimental approach. https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A1d83b1b981122f37e4529a40c914d71d1e784b944a6541cb33d665d92c1f4ed9a;
13. Framework for Modeling and Simulation of Human Lethality, Injury, and Impairment from Blast-Related Threats. https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A1459dd86a43adab8605b2f9a3d0cbac0b6dcdedf7a66f4ec258c90faca9d99d31;
14. Understanding blast-induced neurotrauma: how far have we come? https://www.futuremedicine.com/doi/10.2217/cnc-2017-0006;
15. Review of blast injury prediction models .https://safe.menlosecurity.com/doc/docview/viewer/docN460C2D96D4A1bf203cc70ca924ff447610f6f6f86eaf5f1965f7031c3af1857e0c32f6790cea;
16. Blast Overpressure Induced Pulmonary and Intestinal Damage is Ameliorated by Post-injury Decay Accelerating Factor Injection. https://www.heraldopenaccess.us/openaccess/blast-overpressure-induced-pulmonary-and-intestinal-damage-is-ameliorated-by-post-injury-decay-accelerating-factor-injection;

KEYWORDS: Blast injuries; human medical treatment

VERSION 3

DTRA232-002 TITLE: Real-time Criticality Detection System for Field Operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear; Integrated Sensing and Cyber; Emerging Threat Requirements

OBJECTIVE: The Defense Threat Reduction Agency (DTRA) seeks technologies that can provide Department of Defense (DoD) personnel with the ability to pre-emptively identify and react to situations with potential nuclear criticality concerns. Events involving nuclear reactors or associated facilities and/or materials with unknown operating states (i.e. damage, configuration, or contamination) risk endangering DoD personnel who need to enter the facility or interact with the materials.

Since criticality events have exponential radiation effects, the introduction of additional moderating material, such as a human body, can lead to significant injury or loss of life. This topic is intended to provide additional capability to these response personnel with the following parameters:

(1) High confidence identification of environments requiring criticality safe operation(s) including in areas where contamination may be present
(2) Near real-time response – response and alarms, if necessary, in less than one minute of detector(s) on site
(3) Alarms and/or warning prior to a criticality accident occurring to allow personnel sufficient time to respond
(4) Mobile sensing – system should be reliant on sensors that are reasonably transportable by personnel
(5) Integration into a common operating picture system, such as TAK [1]

This solution should work in a variety of scenarios to range from an unknown contained material through a large, contaminated facility with a potential criticality concern. The majority of the work is expected to be focused on the algorithms, analyses, and data integration. Commercial off the Shelf (COTS) or Government off the shelf (GOTS) sensors should be used, though modifications are allowable if required for detection sensitivity or proper operation.

DESCRIPTION: Nuclear criticality safety is an extensively studied and implemented science in the industrial, regulatory, commercial, government, and academic spheres. The United States Nuclear Regulatory Commission [2] maintains requirements for criticality safety in operational facilities, and there are commercially available systems* for monitoring criticality safety, such as [3]. These systems and procedures are generally intended for controlled scenarios such as operating facilities or the transport of known quantities of materials.

In battlefield or emergency operations, however, the regular operation of procedures or systems may be disrupted, a team may be operating outside of a familiar environment, and/or facilities or materials may be encountered with uncertain states or histories. Furthermore, a team may be in a scenario where transport of large quantities of equipment is difficult or not feasible in a timely manner. These constraints make existing solutions not directly applicable to the DoD missions. There has been extensive progress made with respect to gamma and neutron detectors and the associated algorithms for detecting radioactive materials. This progress is also coupled with the development of data fusion and integration and visualization tools, which provides the potential of applying new science and analysis to this mission space.

VERSION 3

In this topic, DTRA is soliciting novel solutions for near real-time criticality detection to protect on-site personnel. Conceptual solutions may include both gamma and neutron sensing for dual mode criticality analysis, material and personnel localization, fission chain identification, distributed sensing, and/or other
approaches not yet considered. Solutions would ideally be portable and provide near real-time alarm capabilities. Ideal solutions will provide a level of mapping and localization in an eventual product and integrate in a common operating picture, such as TAK.

*This write-up mentions selected commercial products. Any and all products mentioned are for informational purposes only and are not an endorsement by DTRA, the DoD, or U.S. government.

PHASE I: Provide modeling and simulation to demonstrate how the proposed solution for real-time criticality analysis in an uncertain location will function across a range of scenarios, covering simple through complicated environments, with potential criticality concerns. Estimates of sensitivity, cost, required system load outs, and time for identification should be provided. The outcome of the Phase I will be a report summarizing the approach, concept of operations, expected detection capabilities, and uncertainties. A plan should also be included describing the Phase II efforts, how these efforts will meet requirements, and anticipated developmental risks with potential mitigations.

PHASE II: Demonstrate a laboratory-based physical solution for real-time criticality detection for a simplified problem space (i.e. an unknown mass and configuration of fissile material). At the end of Phase II a subset of the system should be operational and demonstrated to provide detection to benchmark results from the Phase I simulation. It is understood that actual fissile material tests may not be feasible at this stage of the development due to regulatory, safety, and security concerns, so an applicable simulated source or data inject will be considered acceptable. At the end of Phase II, it is expected, however, that if a realistic test were to be conducted the system would be in a Technology Readiness Level of 4 (Component and/or Breadboard Validation in a Laboratory Environment).

Refinements for more complicated scenarios including contamination and unknown environments should be considered.

PHASE III DUAL USE APPLICATIONS: Phase III will fully integrate the system and include networking into a common operating picture and provide alarming (both personnel and distributed)
capabilities. The system should be operational with potential for revision due to logistics and user input. At this stage a semi-realistic demonstration should be performed at an appropriate facility to simulate a realistic operation with end-user input. User and operational manuals should be provided and technical capabilities will be mostly complete.

REFERENCES:

1. https://tak.gov/
2. https://www.nrc.gov/
3. MIRION Technologies - CAAS-3S. https://www.mirion.com/products/criticality-accident-alarm-system

KEYWORDS: time sensing and visualization

VERSION 3

DTRA232-003 TITLE: ATAK Secure Routing Solution for CBRN Operations

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems

OBJECTIVE: DTRA seeks the development of a compact, ruggedized, all-in-one network routing solution for tactical use of the CBRN Plug-In within a local Android Team Awareness Kit (ATAK) Server that is compatible with the existing MANET radios currently employed by OI-CO and SOCOM. For DTRA, this will enable Technical Support Groups (TSGs) to utilize the ATAK CBRN Plug-in (CBRNPI) locally in any operational environment regardless of the communications restrictions present in the specific area of responsibility. Further commercialization is envisioned to provide benefit to other Federal Government agencies and to State and Local Governments for needs such as law enforcement and search and rescue.

DESCRIPTION: TSG's are tasked with providing Geographic Combatant Commanders (GCC) with the capability of real-time detection, location, identification, and characterization of CBRN materials of concern. CBRN search operations are often conducted in complex environments that greatly limit standard wireless network connections. Software defined radios that utilize Mobile Ad-hoc Networks (MANET) technology are able to self-heal and scale in number with minimal data throughput degradation even in GPS denied environments. When paired with MANET radios, a local ATAK server with powerful processing capabilities allows operators to fully utilize the ATAK CBRNPI and capture all real-time sensor data regardless of communication restrictions over common networks (e.g., LTE, SATCOM). Integrating both the MANET radio and ATAK server into a router allows operators the option of using both global SIM cards and military SATCOM in a portable package that meets the dismounted SWaP requirements of the TSG's CBRN mission. Currently, no singular government or commercial product exists to conduct edge computing and tactical network routing while also providing a local ATAK server capable of storing historic data from a potentially large number of simultaneously streaming sensors, running individual search and ID algorithms.

Requirements for this development are as follows:

- Router
  - Dual-SIM, Dual-Modem with active fail-over protection
  - 2.4 and 5 GHz with WiFi 6 support
  - 2 x LAN and 1xWAN Ethernet Ports
  - Capable or running an internal VPN
  - Internal LTE antennas
- MANET Radio
  - 6-Watt transmission power with 3x3 MIMO and 120 Mb/s of data throughput
  - L, S, and C band capable with interchangeable modules
  - AES 256 encryption
  - RNDIS ports capable of routing IP traffic
  - Web accessible GUI for specific radio configurations
- ATAK Server
  - Quad core I7 processor
  - 32 GB DDR4 RAM
  - 1TB SSD
  - x86 (not ARM) compatible with Linux based OS interoperable with ATAK Server requirements
  - No cooling required
- SWaP:

- o Approximate dimension of final packaging must be less than 5" x 5" x 3"
- o Less than 3 lbs in weight
- o Capable of running off of both a standard military 2590 or 2557 Lithium battery and 120/240 VAC (power source should not be included in dimension and weight requirements)
- o Capable of swapping batteries with no loss of configured router, radio, or server settings
- o IP Rating of no less than IP44
- o Internal LTE antennas
- o 3 x flexible radio antennas with horizontal and vertical polarization

- User Interface – centralized location that displays the following:
  - o Static IP addresses for the LAN, MANET radio, and ATAK Server
  - o Current VPN status
  - o Hyperlink to MANET radio GUI
  - o Current SIM/s status

PHASE I: ATAK Router development will start with the performer conducting thorough market research of the individual COTS and GOTS solutions that are currently available and meet the above requirements of each component/subcomponent. Once the correct COTS/GOTS solutions are identified, a lab bench style integration will be conducted followed by a live demonstration that validates the the propoased approach while establishing the feasibility of the chosen configuration of integrated components. The demonstration will result in a relavant display of data in the ATAK CBRNI. Further refinement will focus on modification/replacement of the individual components to better meet SWaP and User Interface requirements. Phase 1 should culminate with two protoypes that successfully demonstrate the ability to meet the requirements listed in the Desription Section.

PHASE II: This portion of development should focus on system refinements, such as to SWaP, and refining the GUI to meet requirments. An additiononal focus should be on the development of a commercially available kit that includes user cables, manuals, user training curriculum, and outer storage packaging of the now COTS ATAK Router. The final deliverable will be six ATAK Router Kits with an intended focus towards SOCOM users.

PHASE III DUAL USE APPLICATIONS: No entry

REFERENCES:

1. An Overview of MANET Technologies – Finabel, (https://finabel.org/wp-content/uploads/2022/10/48.-An-Overview-of-MANET-Technologies-Advantages-and-Disadvantages-in-the-Military.pdf);
2. ATAK Product Center, (https://atak.gov);
3. Arnhouse Digital Device Corporation - ADDC, (https://addc.com/product/biodigitalpc-12x/);
4. Comparing Dual SIM vs Dual Modem – CradlePoint, (https://cradlepoint.com/resources/blog/comparing-dual-sims-vs-dual-modems/);
5. What is Wifi 6? – Intel, (https://www.intel.com/content/www/us/en/gaming/resources/wifi-6.html);
6. BB-2590/U, 9.9 AH – BrenTronics, (https://www.bren-tronics.com/bt-70791cg.html);

KEYWORDS: Tactical Edge Computing; ATAK; CBRN Search; IoT; Software Defined Tactical Mesh Radio; Single Board Computers

VERSION 3

DTRA232-004 TITLE: A Portable Hardware Solution for Real-Time DNA and RNA Sequencing

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology

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 the Announcement. 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: DTRA seeks to develop a US-based, portable, open-architecture tablet designed for SOCOM ATAK users that is capable of visualizing and conducting real-time DNA or RNA sequencing in a tactical environment. Further commercialization is envisioned to provide benefit to other government users of the ATAK situational awareness environment by providing real-time~~, presumptive~~ DNA or RNA sequencing with field awareness to decision makers.

DESCRIPTION: Biological Warfare Agent (BWA) detection and identification options for SOCOM users are limited in both available technologies and scope of the ID capaility ~~and library size~~. Lab-based theater confirmatory DNA and RNA sequencing are possible, but not technically or tactically feasible for SOCOM operators at this time. Additionally, the methods employed by operators, Hand Held Assay ~~Hereditary Hemolytic Anemia~~ (HHA) and Polymerase Chain Reaction-based (PCR) tools, are definitively limited to known and specifically targeted BWAs ~~by their BWA library sizes~~. Sequencing, however, is capable of having a BWA library that is only limited by available processing power and available genomic data ~~and hard drive space~~. The specific need for SOCOM users is a stand-alone tablet capable of targeting low complexity, high biomass BWA samples in a time-constrained tactical environment. When combined with the ATAK CBRN Plug-in (CBRNPI), on-target sequencing results will be viewable in real-time by CONUS/OCONUS laboratories, and decision-makers at the Joint Operations Center (JOC). Applying ATAK to this sequencing effort prevents potential sampling errors by employed operators, and also drastically reduces the decision-making timeline by providing near real-time results.

Requirements for this development are as follows:

- Tablet SWaP:
  - Utilizes Nanopore Technology 512 Channel MinION Flow Cell ~~and Flongle~~
  - LED touch screen, approximate dimensions 6” x 4”
  - Approximate overall dimensions, 6.5” x 6” x 1”
  - Weight = <2.0 lbs
  - 1 x GB Ethernet LAN port
  - 1 x Thunderbolt 4 USB-C connection
  - Powered by Mil Spec-2590 lithium battery or 120/240 VAC
  - Micro SD Card slot with 1TB support
  - Tablet is Static IP and DHCP Configurable
  - Capable of emitting Wifi 6 to make a wireless connection to an android end user device ~~phone~~
- Minimum Computational Requirements
  - Quad Core I7, 8th Gen or newer
  - 32 GB DDR4 RAM

VERSION 3

- o x86 capable of running Linux-based OS
- o 1 TB SSD
- o No additional cooling required
- o Hot-swappable server blade
- • ATAK Integration
- o Integration into the ATAK CBRNPI utilizing ProtoBuff programming language partnered with a DTRA-approved ATAK CBRNPI Developer

PHASE I: Begin with a market research study of potential COTS hardware solutions that meet SWaP requirements. Demonstrate the feasibility of integrating and confirming the compatibility of a processor unit to the Nanopore Technologies (NPT) MinION in such a way that would result in a small form factor as described in the requirements. Additionally, start development of the sequencing software GUI. Also, demonstrate the feasibility of connecting this integrated unit to an Android based end user device. Integrate a BWA library into the sequencer's computer in coordination with the DTRA project team. Conduct successful benchtop functionality test consisting of a standalone computer for visualization, sequencing computer, MinION reader, and pre-prepared reagent sample. Culminate Phase 1 with a digital rendering of a tablet prototype to include a conceptual engineering breakdown of the components and software that is physically capable of integrating the NPT MinION flow cells utilizing respective COTS hardware components to meet the outlined requirements.
~~Start development of the sequencing software GUI utilizing the identified small form factor computer for processing but visualized using a separate computer. Integrate and confirm the compatibility of the stand-alone Nanopore Technologies MinIon. Integrate the DTRA OI-CO BWA library into the sequencer's computer. Conduct successful benchtop functionality test consisting of a standalone computer for visualization, sequencing computer, MinIon reader, and pre-prepared reagent sample. Culminate Phase 1 with a digital rendering of a tablet prototype that is physically capable of integrating either the NPT MinION or Flongle flow cells utilizing respective COTS hardware component that meets the outlined requirements.~~

PHASE II: Focus on building, testing, and refining with an integrated initial prototype ~~the 3D-printed prototype~~. After full functionality is achieved with the prototype, begin integration of the sequencer into the ATAK CBRNPI. Post ATAK integration, the prototype sequencer will need to conduct a successful benchtop test while also being remotely viewable within ATAK. Pending a successful functionality test, a minimum of two fully functional sequencers will need to be created with a final packaging of either machined aluminum or injection-molded polymer that meets all final SWaP requirements. Discussion will occur with the DTRA program team about future integration into a fully equipped sequencing kit. DTRA seeks an end state that results in a single device that can run the MinION, utilize the MinION software (MinKNOW) to catalogue data, and feed the raw data streaming from the MinKNOW into a GUI connected to the ATAK CBRNPI. ~~The remaining portion of Phase II should focus on designing and creating two fully equipped sequencing kits that can be utilized for additional user testing. The culmination of this phase should include identifying a future manufacturer and cost for sequencing kits.~~

PHASE III DUAL USE APPLICATIONS: No entry

REFERENCES:

1. Nanopore Technologies, MinION -https://nanoporetech.com/products/minion;
2. Handheld Genomic Sequencer Shows Promise in Field Demo - https://www.army.mil/article/209780/handheld_genomic_sequencer_shows_promise_in_field_demo;

3. Sequencer for soldiers: battlefield genomics -https://nanoporetech.com/resource-centre/sequencers-soldiers-battlefield-genomics-0;
4. Arnhouse Digital Devices Corporation, BioDigital PC12X -https://addc.com/product/biodigitalpc-12x/;

KEYWORDS: Biosequencing; Portable Genomic Sequencing; ATAK Situational Awareness; Edge Computing

VERSION 3

DTRA232-005 TITLE: Field Calibration of Standoff, Ground-Based Hyperspectral Imaging Sensors Used for Vapor Mass Quantification of Plumes

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): General Warfighting Requirements (GWR); Emerging Threat Requirements

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 the Announcement. 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: Collateral effects predictions are a major consideration for decision-makers when planning counter weapons of mass destruction (C-WMD) operations as unintentional releases of WMD materials can harm non-combatants and have significant strategic implications. In order to study the effectiveness of C-WMD technologies and tactics, researchers use standoff, ground-based long wave infrared (LWIR) hyperspectral imaging (HSI) to quantify the vapor mass of specific chemicals in plumes resulting from explosive-driven test events. The vapor mass quantification measurements are particularly sensitive to the difference in temperature between the plume and the background, which could include some combination of bare-earth, vegetation, blue-sky, and/or clouds. The objective of this topic is to develop a method for calibrating HSI systems for vapor mass quantification of plumes with different backgrounds to increase measurement accuracy and provide estimates of measurement uncertainty.

DESCRIPTION: The use of LWIR HSI for standoff vapor mass quantification of plumes has proven very useful for evaluating the ability of C-WMD technologies and tactics to minimize unintentional chemical releases and the associated collateral effects. Thorough field calibration of these systems, including the ability to adjust measurements for different environmental and background conditions, has proven difficult.

The near term simulant of interest is Diisopropyl methylphosphonate (DIMP), which is generally disseminated as a fine aerosol and must evaporate before HSI vapor mass measurements can occur. At the same time the fringes of the plume are diffusing and dropping below the HSI pixel detection threshold. This means we will always have less than 100% recovery for an artificial plume with a known mass. A system or method enabling the quantification of HSI capabilities as a function of both chemical mass and thermal background is desired. Required vapor masses range from 10s of grams to 10s of kilograms, and the absolute differential between ambient and background thermal backgrounds in the LWIR range from 1° C to 15° C.

To-date, artificially generated plumes from a ground-based disseminator have provided limited calibration data, however, the system relied on evaporation of fine aerosols, requiring long spray durations to achieve desired vapor masses and total mass quantification was limited by environmental diffusion effects. Further, the ground-based dissemination system was limited to highly variable thermal backgrounds, e.g., mix of background terrain, horizon, and sky background, and therefore unable to develop calibration curves as a function of thermal background conditions.

VERSION 3

Development of an unmanned-aerial-system (UAS) disseminator to release an in-scene reference plume with known vapor mass and sky background would overcome some of the limitations of the ground-based system. Other approaches are also of interest and encouraged for this solicitation.

PHASE I: Demonstrate concepts to calibrate an HSI system by generating well-characterized in-scene reference plumes or other calibration targets. Demonstrate that the system could be used to study the effects of different backgrounds, plume heights, and/or temperature differentials. A plan should also be submitted outlining the approach for scaling the system to meet Phase II requirements.

PHASE II: Demonstrate the ability of the system to perform HSI calibration and account for the parameters of interest. Systems that generate in-scene reference plumes should be capable of using DIMP or other common simulant materials. All data collected during the demonstration and analysis of the system will be included in the final report along with a user's manual and a data package on all critical system components. Hardware developed will also be delivered to the government.

PHASE III DUAL USE APPLICATIONS: Phase III will demonstrate and deliver a complete HSI calibration system capable of accounting for all the parameters of interest. Commercialization strategies will depend heavily on the approach chosen but at a minimum will include sales of systems/services to scientific and commercial users of HSI.

REFERENCES:

1. Gallagher, Neal & Wise, Barry & Sheen, David. (2003). Estimation of trace vapor concentration-pathlength in plumes for remote sensing applications from hyperspectral images. Analytica Chimica Acta. 490. 139-152. 10.1016/S0003-2670(03)00177-6.
2. Gallagher, Neal & Wise, Barry & Sheen, David. (2003). Error Analysis for Estimation of Trace Vapor Concentration Pathlength in Stack Plumes. Applied spectroscopy. 57. 614-21. 10.1366/000370203322005283.
3. Hall, Jeffrey & Boucher, Richard & Buckland, Kerry & Gutierrez, David & Keim, Eric & Tratt, David & Warren, David. (2016). Mako airborne thermal infrared imaging spectrometer: performance update. Proc. SPIE 9976, Imaging Spectrometry XXI, 997604.
4. Ifarraguerri, Agustin & Ben-David, Avishai. (2008). Impact of atmospheric boundary layer turbulent temperature fluctuations on remote detection of vapors by passive infrared spectroscopy. Optics express. 16. 17366-82. 10.1364/OE.16.017366.
5. Sheen, David & Gallagher, Neal & Sharpe, Steven & Anderson, Kevin & Schultz, John & Shen, Sylvia & Lewis, Paul. (2003). Impact of background and atmospheric variability on infrared hyperspectral chemical detection sensitivity. Proceedings of SPIE - The International Society for Optical Engineering. 5093. 10.1117/12.488931.
6. Young, S.J.. (2023). Detection and Quantification of Gases in Industrial-stack Plumes Using Thermal Infrared Hyperspectral Imaging.

KEYWORDS: Sensor; modeling; plume; UAS; dispersion; CBRN; weapons; simulant

VERSION 3

DTRA232-006 TITLE: Standoff Aerosol Plume Density and Particle Size Quantification

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): General Warfighting Requirements (GWR); Emerging Threat Reduction

OBJECTIVE: The objective of this effort is to develop, calibrate, verify and validate a standoff ground-based optical system capable of measuring aerosol plume density and particle size distribution.

DESCRIPTION: In order to quantify the inadvertent release of hazardous material associated with the destruction of threat chemical and biological facilities, DTRA seeks to develop a capability to remotely sense aerosol plume density and particle size distribution.

Past efforts to quantify aerosol plumes have used hyperspectral imaging, single-color LIDAR, and other similar technologies. While these technologies have been used to assess plume densities, they are ill-suited to measuring particle size distribution. Quantification of both variables is essential to assessing the total potential exposure to a local population as well as to estimating how far a plume is expected to propagate in the environment.

Currently, the only technique available to accurately quantify aerosol plume parameters [1] is the placement of point sensors within the envelop of a plume. However, this technique cannot be applied in most operational environments. Prior published work [2-6] has shown that some optical systems may provide the ability to estimate particle size distribution.

The phase III end state of this work is to deliver an optical system to the warfighter that provides a standoff ground-based optical sensor capable of measuring aerosol plume density and particle size distribution. It should be able to measure particles in the 2-40 micron range, operate at a stand-off distance of 300 m to 3 km, and be eye safe (preferred but not required).

PHASE I: Demonstrate the concept in a controlled laboratory or similar environment, identifying limits of detection related to aerosol particle sizes, aerosol concentrations, and stand-off distances. Ideally, at this scale, generating a well-characterized aerosol environment in an aerosol chamber that can achieve a steady-state condition is conducive to quantification of aerosol concentration and particle size distribution with verification and validation using several aerosol particle size and concentration point sensors inside of the aerosol chamber. The optical diagnostic capability could sample the aerosol chamber contents through opening shutters. Verification and validation should also include testing with both wet and dry aerosol particles, as well as testing under day and night time lighting conditions. The goal is to have a statistical confidence of >90% for aerosol concentration and particle size distribution demonstrated under the steady-state aerosol conditions in a controlled environment.

PHASE II: 1) Develop an initial prototype system capable of operating in a field environment. 2) In an open-air controlled test, validate quantification capability against a well-characterized aerosol source by statistically determining the level of agreement with a point source ground truth sensor and having a goal of obtaining statistical confidence of >90% for aerosol concentration and particle size distribution. Quantification efforts should include comparisons within an identified aerosol region where theoretical concentrations and particle size distributions can be verified with aerosol concentration and particle size point sensors. This open air controlled aerosol region could be within a plume Taylor Cone or a Steady State regime. Several different concentrations and distances should be selected in this validation effort, to compare to the limits of detection defined in Phase I testing. Later phases of open air testing should introduce wind effects.

PHASE III DUAL USE APPLICATIONS: 1) Deliver a final prototype 2) Integrated Aerosol and Vapor Applications: Validate and Verify quantitation efforts, including a full-scale test, with a DoD, DoE Laboratory or commercial partner to integrate aerosol data with Hyperspectral Imaging data sets to account for total plume mass quantification.

REFERENCES:

1. Kovalev, V. Eichinger, W. (2004) Elastic Lidar: Theory, Practice and Analysis Methods. Wiley Warren, Russell & Vanderbeek, Richard & Ben-David, Avishai & Ahl, Jeffrey. (2008). Simultaneous estimation of aerosol cloud concentration and spectral backscatter from multiple-wavelength lidar data. Applied optics. 47. 4309-20. 10.1364/AO.47.004309.
2. Marchant, Christian. (2010) Retrieval of aerosol mass concentration from elastic lidar data. PhD Dissertation in Electrical Engineering, Utah State University, Logan, UT
3. Huige, Di & Wang, Qiyu & Hangbo, Hua & Li, Siwen & Yan, Qing & Liu, Jingjing & Song, Yuehui & Hua, Dengxin. (2018). Aerosol Microphysical Particle Parameter Inversion and Error Analysis Based on Remote Sensing Data. Remote Sensing. 10. 1753. 10.3390/rs10111753.
4. Jagodnicka, Anna & Stacewicz, Tadeusz & Karasiński, Grzegorz & Posyniak, Michał & Malinowski, Szymon. (2009). Particle size distribution retrieval from multiwavelength lidar signals for droplet aerosol. Applied Optics. 48. B8.
5. Kolgotin A, Müller D, Chemyakin E, Romanov A. Improved identification of the solution space of aerosol microphysical properties derived from the inversion of profiles of lidar optical data, part 1: theory. Appl Opt. 2016 Dec 1;55(34):9839-9849. doi: 10.1364/AO.55.009839. PMID: 27958480.

KEYWORDS: Lasers; Spectroscopy; Weapons; CWMD; Aerosol Plume; Agent Defeat; Optics

Office of the Under Secretary of Defense for Research and Engineering
Deputy Chief Technology Officer for Science & Technology
DCTO(S&T) – Quantum Science Topics
23.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The Office of the Under Secretary of Defense, Research and Engineering (OUSD(R&E) Deputy Chief Technology Officer (DCTO) for Science and Technology (S&T) Office in partnership with the DCTO(S&T) Quantum Science Office seeks to advance scientific discoveries in alignment with the USD(R&E) Quantum Science Roadmap and provide a mechanism to further scientific development, maturation, and commercialization of quantum science technologies. The DCTO(S&T) SBIR program aims to stimulate technological innovation, strengthen the role of small business in meeting DoD research and development needs, foster and encourage participation by minority and disadvantaged persons in technological innovation, and increase the commercial application of DoD-supported research or research and development results. **The DCTO(S&T) SBIR program solicits approaches that combine high-risk with potential for high-reward to address scientific challenges described in the topics below.**

Proposers responding to a topic in this BAA must follow all general instructions provided in the Department of Defense (DoD) SBIR Program BAA.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

DCTO(S&T) specific requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Specific questions pertaining to the administration of the OUSD(R&E) DCTO(S&T) Quantum Science Office SBIR Program and these proposal preparation instructions should be directed to: Dr. Karl Dahlhauser, karl.j.dahlhauser.civ@mail.mil.

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Technical Volume (Volume 2)

The technical volume is not to exceed 15 pages of Times New Roman size 11 font and must follow the formatting requirements provided in the DoD SBIR Program BAA. Any pages in the technical volume over 15 pages will not be considered in proposal evaluations.

Cost Volume (Volume 3)

Cost and duration limits will be outlined in each topic. Costs must be clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. OUSD(R&E) DCTO(S&T) Quantum Science Office will occasionally accept deviations from the POW requirements with written approval from the Funding Agreement officer.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by the OUSD(R&E) DCTO(S&T) Quantum Science Office during proposal evaluations.

Supporting Documents (Volume 5)
In addition to those required in the DoD Program BAA, supporting documents will be accepted/required as indicated in each topic.

PHASE II PROPOSAL GUIDELINES
Phase II proposals may only be submitted by Phase I awardees. Phase II duration and cost limits will be outlined in each topic.

DIRECT TO PHASE II (DP2) PROPOSAL GUIDELINES
15 U.S.C. §638 (cc), as amended by NDAA FY2012, Sec. 5106, and further amended by NDAA FY2019, Sec. 854, PILOT TO ALLOW PHASE FLEXIBILITY, allows DoD to make a SBIR Phase II award to a small business concern with respect to a project, without regard to whether the small business concern was provided an award under Phase I of the SBIR program with respect to such project. OUSD(R&E) DCTO(S&T) Quantum Science Office will conduct a "Direct to Phase II" implementation of this authority for select topics under this BAA, as specified in these instructions.

Each eligible topic requires that proposers provide documentation to demonstrate that the feasibility described in the Phase I section of the topic has been met. **Feasibility documentation cannot be based upon or logically extend from any prior or ongoing federally funded SBIR or STTR work.** Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposer must either own the IP, or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work.

If the proposer fails to demonstrate technical merit and feasibility equivalent to the Phase I level as described in the associated topic, the related Phase II proposal will not be accepted or evaluated.

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Proposers are required to submit proposals via DSIP. Proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR/STTR Program BAA.

A complete proposal consists of the following:
Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents
Volume 6: Fraud, Waste and Abuse Training

Follow the instructions and guidance provided in section 5.3 of the DoD Program BAA for completing these proposal volumes.

Technical Volume (Volume 2)
The technical volume for DP2 proposals consist of two parts:

- **PART ONE: Feasibility Documentation**: Provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of the topic has been met and describes the potential commercial applications. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. **Maximum page length for feasibility documentation is 10 pages**. If you have references, include a reference list or works cited list as the last page of the feasibility documentation. This will count towards the page limit. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the PI. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposer must either own the IP, or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work. Documentation of IP ownership or license rights shall be included in the Technical Volume of the proposal. DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated.
- **PART TWO: Technical Proposal:** Content of the Technical Volume should cover the items listed in section 5.3.c. of the DoD SBIR Program BAA. **The maximum page length for the technical proposal is 15 pages.**

Cost Volume (Volume 3)
Cost and duration will be outlined within each topic. Costs for the Base and Option must be separated and clearly identified on the Proposal Cover Sheet (Volume 1) and in Volume 3.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR/STTR Program BAA for full details on this requirement. Information contained in the CCR will be considered by DCTO(S&T) during proposal evaluations.

Supporting Documents (Volume 5)
In addition to those required in the DoD Program BAA, supporting documents will be accepted/required as indicated in each topic.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
The OUSD(R&E) DCTO(S&T) Quantum Science Office will not participate in the Technical and Business Assistance.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the BAA.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.

As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil.

OSD Quantum Science SBIR 23.2 Topic Index

OSD232-001 TITLE: Application-Specific Photonic Integrated Circuit (PIC) for a Quantum System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science

OBJECTIVE: Develop an application-specific photonic integrated circuit to serve a specific quantum system (e.g. Rydberg sensor, clock transition). The device should integrate into and be demonstrated with an already existing quantum sensor.

DESCRIPTION: Quantum sensors have demonstrated the ability to surpass classical sensors in areas such as clocks [1], Rydberg sensors [2], and magnetometers [3]. Currently, these devices have limited deployment due to factors such as the large SWaP, a lack of environmental robustness, and limited scalability. A major hurdle in overcoming these issues is the size and construction of typical laser systems associated with the quantum sensors. One solution is the development of a photonic integrated circuit (PIC) [4]. These devices have been shown to significantly reduce the size of a laser system through lithographically small structures in materials such as lithium niobate, silicon nitride, or aluminum nitride while being able to be manufactured at scale. Additionally, they offer significant increases in robustness due to factors such as vibrations [5]. The DoD seeks the development of an application specific PIC to serve a specific quantum sensor or clock as well as the integration into said sensor. Because of the plethora of quantum sensors, the call does not specify a sensor or clock, but rather allows the proposer to suggest their own. This is a call for the integration of a quantum sensor with a PIC, not for the development of a quantum sensor. This may include the development of the laser as well as other components on the photonically integrated circuit, such photodiodes, modulators, optical isolators, waveguides/passive structures, etc. A final integration with a quantum sensor and subsequent demonstration will be required.

PHASE I: A successful phase I will outline the device and a demonstration of feasibility. This can be through extensive modeling, with validation of models being preferred. An already constructed quantum sensor should be described with a path towards integration. Phase I Base amount must not exceed $295,000 for a 12-month period of performance.

PHASE II: Phase II is a prototype delivery of the PIC and quantum sensor to the government. The device should demonstrate the integration of the fabricated photonically integrated circuit with the quantum sensor and display a path towards larger quantities of production. Phase II Base amount must not exceed $1,300,000 for a 24-month period of performance and the Option amount must not exceed $650,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: This technology can be used for multiple military technologies such as inertial sensors (accelerometers, gyroscopes), gravity gradiometers, magnetometers and atomic clocks and has a dual use for the same applications in the commercial section.

REFERENCES:

1. Ludlow, A. D., Boyd, M. M., Ye, J., Peik, E., and Schmidt P. O., Optical atomic clocks. Rev. Mod. Phys. 87, 637 (2015).
2. Adams, C. S., Pritchard, J. D., Shaffer, J. P., Rydberg atom quantum technologies. J. Phys. B: At. Mol. Opt. Phys. 53 012002 (2020)
3. Budker, D., Kimball, D. F. J., Optical Magnetometry. Cambridge University Press (2013).
4. Blumenthal, D., Photonic integration for UV to IR applications. APL Photonics 5, 020903 (2020).
5. Niffenegger, R.J., Stuart, J., Sorace-Agaskar, C. et al. Integrated multi-wavelength control of an ion qubit. Nature 586, 538–542 (2020).

KEYWORDS: Quantum; photonic integrated circuits; quantum sensors; lasers; photonics; quantum sensor

OSD232-D02 TITLE: Manufacturable High-Performance Magnetometers

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Biotechnology; Quantum Science

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 the Announcement. 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 an accessible, high-performance scalar gradiometric magnetometer that can be reliably produced. The device architecture should focus on simplifying and streamlining the manufacturing of a scalar gradiometric magnetometer that already meets DoD-relevant performance specifications.

DESCRIPTION: The DoD has a need for magnetometers for applications such as magnetic navigation, magnetic anomaly detection, and medical imaging such as magnetoencephalography (MEG) and magnetocardiography (MCG). Quantum magnetometers, specifically optically pumped magnetometers (OPMs) [1], have advanced significantly in recent years and surpassed conventional sensors and superconducting quantum interference devices (SQUIDs). The most sensitive OPMs require extensive magnetic shielding [2], but recently, scalar gradiometric magnetometers capable of operating in Earth's field have been demonstrated with similar sensitivities [3]. Though significant advances have been made in the performance of scalar gradiometric magnetometers, one aspect that prevents their widespread use is their manufacturability. For DoD-relevant missions, there is a need for a manufacturable scalar gradiometer that can be deployed across a variety of domains and at large scale. The goal of this program is to streamline the production of high-performance scalar gradiometric magnetometers. The device should be a complete, fieldable product, including but not limited to electronics, sensor head, laser, etc.

PHASE I: This topic is accepting Direct to Phase II proposals only. To qualify for Direct to Phase II, sufficient evidence of a previous externally funded effort that specifically addresses high performance optically pumped scalarmagnetometers should be demonstrated. The scalar magnetometer should have a sensitivity of 20 fT/rtHz, a sensor head size of roughly 15 mm x 15 mm x 7 cm and operate in an ambient magnetic field of up to 100 uT. The power consumption, electronics, data rate, bandwidth, temperature operation range, and gradient and total field range, sensitivity, and accuracy should be discussed.

PHASE II: Redesign and build at least 5 optically pumped scalar magnetometers with specifications descried in Phase 1. Clear advancements in manufacturability should be demonstrated indicating the capability for mass manufacturing. Demonstrated metrics for manufacturability should include but not be limited to cost (<$5000), fabrication timelines (<3 months), and yield (>80%). Phase II Base amount must not exceed $1,300,000 for a 24-month period of performance and the Option amount must not exceed $650,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: This technology can be used for multiple military technologies such as magnetic anomaly detection or magnetic navigation but has a dual use for medical applications such as magnetoencephalography or magnetocardiography.

REFERENCES:

1. Budker, D., Kimball, D. F. J., Optical Magnetometry. Cambridge University Press (2013).

2. Kominis, I., Kornack, T., Allred, J. et al. A subfemtotesla multichannel atomic magnetometer. Nature 422, 596–599 (2003).
3. Lucivero, V.G. and Lee, W. and Limes, M.E. and Foley, E.L. and Kornack, T.W. and Romalis, M.V., Femtotesla Nearly-Quantum-Noise-Limited Pulsed Gradiometer at Earth-Scale Fields. Phys. Rev. Appl. 18, L021001 (2022).

KEYWORDS: Magnetometry; magnetic navigation; scalar gradiometry; scalar magnetometry; quantum magnetometer

OSD232-003 TITLE: Efficient Integration or Direct Growth on SOI of Foundry-Scale CMOS Compatible Second Order Nonlinear Materials and/or Short-Wavelength Photonic Materials with Low Optical Loss

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science

OBJECTIVE: Development of a foundry-compatible, direct growth in a Silicon on insulator (SOI) stack, second-order nonlinear material that can be that can be used for photon conversion and low loss waveguides.

DESCRIPTION: Silicon on insulator (SOI) has been a growing standard platform for foundry-scale (300mm) integrated photonics. In that platform modulation and switching are done with mainly with thermal or carrier injection-based devices since silicon's crystalline structure is centrosymmetric and therefore does not have a second-order nonlinearity. These methods of modulation are either slow (thermal) or lossy (carrier injection) and for low loss demanding applications such as quantum photonics make the systems tough to scale. Secondly, for quantum or frequency conversion applications silicon or silicon nitride gives no native access to the second order nonlinearity (unless acquired through electric field induced changes or strain tuning) and therefore must rely on the weaker third order nonlinearity. The ability to have a second order nonlinear material would allow for efficient photon generation/conversion, as well as high speed low-loss optical modulation for classical and quantum applications. The goal of this effort is to identify, develop, and demonstrate second order nonlinear materials that operate in the visible and infrared (400-1700nm) and can be directly integrated with the foundry scale SOI platform.

PHASE I: Identify a set of second order nonlinear materials that are foundry compatible with the 300mm SOI platform. Demonstrate on the small scale (<300mm) the integration of these materials on an SOI platform. The information and research conducted during the Phase 1 will be delivered as a final report. Phase I Base amount must not exceed $295,000 for a 12-month period of performance.

PHASE II: Demonstration of the integration of foundry capable second order nonlinear materials on the 300mm SOI platform. The required deliverables for the demonstration are analysis and data of the material quality on the SOI platform, development and demonstration of devices that show the modulation and switching capabilities of the material, and development and demonstration of devices that show nonlinear photon generation and conversion. The samples will be delivered to the DoD for further analysis along with a plan to transition to a foundry. Phase II Base amount must not exceed $1,300,000 for a 24-month period of performance and the Option amount must not exceed $650,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: The resulting efforts under Phase II can be transitioned to commercial applications for high-speed data encoding for optical communication applications, and lidar applications. These applications are relevant as well to the DoD. The research can be transitioned for the use of entangled photon generation for quantum communication, quantum networking, entanglement distribution, and quantum computing.

REFERENCES:

1. Lu, T.J., Fanto, M., Choi, H., Thomas, P., Steidle, J., Mouradian, S., Kong, W., Zhu, D., Moon, H., Berggren, K. and Kim, J., 2018. Aluminum nitride integrated photonics platform for the ultraviolet to visible spectrum. Optics express, 26(9), pp.11147-11160.
2. Fan, R., Lin, YY., Chang, L. et al. Higher order mode supercontinuum generation in tantalum pentoxide (Ta2O5) channel waveguide. Sci Rep 11, 7978 (2021).

KEYWORDS: Integrated photonics; second-order nonlinearity; optical waveguides; foundry compatible; low loss waveguides; visible integrated photonics

OSD232-D04 TITLE: Gravity Gradiometer Demonstration on an Inertial Platform

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science

OBJECTIVE: This project will demonstrate the operation of a single-axis gravity gradiometer with a noise floor below at approximately 10 Eotvos (or similar performance if already demonstrated) on a moving platform in environments where vibrations, accelerations, rotations, and temperature swings cannot be neglected.

DESCRIPTION: Atomic gravity gradiometers are quantum sensors that offer state-of-the-art performance under laboratory conditions [1]. Compared to existing classical approaches, they offer superior sensitivity and reduced size, weight, and power (SWaP). However, their operation is currently limited to static or quasi-static environments achieved through environmental isolation. Dynamic environments present challenges that have hampered the commercialization of devices for fielded operation [2,3].

This solicitation seeks a robust single-axis gravity gradiometer (GG) prototype with performance and SWaP comparable to state-of-the-art atomic devices (10 Eotvos or similar performance if already demonstrated, where 1 E= 10^{-9} second^{-2}) but capable of operation in environments where vibrations, acceleration and rotations may be present. In contrast to gravimeters, GGs enable common mode rejection of certain platform motions, reducing the time averaging required to detect anomalous mass distributions. Therefore, GGs offer advantages over gravimeters for certain applications such as the detection of underground features (e.g. tunnels or voids). Furthermore, these devices can augment inertial navigation systems by distinguishing between gravitational and inertial acceleration.

Ideally, this sensor will have a clear path to commercialization, relying on few, if any, precision-machined components. While this effort is expected to require integration into an inertially stabilized platform, proposers are encouraged to offer innovative concepts that explore cutting-edge physics to solve the challenges of fielding gravity gradiometers.

PHASE I: This topic is accepting Direct to Phase II proposals only. Documentation to determine if Phase I feasibility has been met:

- Existing operational GG hardware with a path to meet the Phase II metrics
- Demonstrated acceleration accuracy less than 10 microGal
- GG integrates to under 200 E within 1000 seconds
- Total system volume of less than 50 L
- Weight less than 50 kg
- Power consumption less than 200 W

PHASE II: The gravimeter developed in this effort shall measure the spatial gradient of the vertical component of gravity along the vertical direction (i.e. the Gzz component of the tensor, where z is the surface normal). Phase II Base amount must not exceed $1,450,000 for a 24-month period of performance and the Option amount must not exceed $250,000 for a 12-month period of performance.

The base portion of Phase II will develop a device that can operate as a GG in the presence of motion. It should meet or exceed the following metrics:

- Acceleration measurement precision of 10 microGal / rt(Hz)
- Short term GG sensitivity of less than 50 E / rt(Hz)
- GG statistical uncertainty of 5 E within 600 seconds of averaging
- Total system volume (including any inertial stabilization) less than 40 L
- Weight less than 30 kg
- Power consumption less than 150 W

These specs must be met under environmental test conditions consisting of:
- Rotations up to 15 deg/s
- Accelerations within +/- 0.1 g of local gravity
- Random vibrations of 0.5 grms
- Operating temperatures between -10 and 40 degC

This will entail a thorough analysis of the sensor performance in the presence of dynamics with the appropriate mitigations in place.

The Phase II option period will focus on a vehicle demonstration. The device must therefore be self-contained, and mobile enough to be loaded onto an appropriate vehicle. The vehicle can be assumed to provide standard wall-plug power.

PHASE III DUAL USE APPLICATIONS: GG capable of fielded operation on a moving platform would have dual-use applications in mineral, oil, and gas exploration, civil engineering, gravity mapping, hydrology, and geophysics.

REFERENCES:

1. M. J. Snadden, J. M. McGuirk, P. Bouyer, K. G. Haritos, and M. A. Kasevich, “Measurement of the Earth's Gravity Gradient with an Atom Interferometer-Based Gravity Gradiometer,” Phys. Rev. Lett. 81, 971 (1998).
2. B. Stray et al., “Quantum sensing for gravity cartography,” Nature 602, 590 (2022).
3. C. Janvier, “A compact differential gravimeter at the quantum projection noise limit,” arXiv 2201.03345 (2022).

KEYWORDS: Atom Interferometry; Gravity Gradiometer; Fieldable Quantum Sensor

OSD232-D05 TITLE: Rydberg-Atom-Compatible Alkali-Metal Vapor Cells with Nontraditional Geometries

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Integrated Network Systems-of-Systems; Quantum Science

OBJECTIVE: Develop rubidium and cesium vapor cells with a thin rectangular geometry that are compatible with the excitation of Rydberg atomic states.

DESCRIPTION: Vapor cells containing dilute gaseous samples of alkali metals (particularly cesium and rubidium) are a critical component in many quantum technologies relevant to the DoD mission. In particular, quantum electric field sensors based on highly excited Rydberg atomic states in thermal vapors are an emerging platform for receiving radio-frequency communications, calibrating antennas, and imaging teraHertz-frequency (THz) electromagnetic sources. Cell geometries beyond traditional cubic and cylindrical designs will be advantageous for optimizing sensor performance and extending the technology's applications.

Reliably obtaining vapor cells with nontraditional geometries that are also capable of supporting excitation to Rydberg states is an ongoing challenge for DoD researchers. Producing vapor cells with consistent alkali vapor pressures, low permeability, and appropriate optical coatings is already something of an art form. Highly reactive rubidium precludes using many materials for enclosures, coatings, and integrated structures. Moreover, alkali metal tends to deposit on inner surfaces, reducing transmission of probing laser beams and creating a Faraday cage that shields low-frequency electromagnetic fields. The ability to excite Rydberg levels is a further challenge due to the various optical wavelengths involved and their propensity to induce unwanted charging on cell surfaces, which perturbs the atoms. Even in cells that support stable ground-state populations, collisions of Rydberg atoms with background gasses, interactions with surface charges, and other chemical reactions can suppress excitations to Rydberg states. The goal of this SBIR is to foster reliable development and delivery of rubidium and cesium vapor cells with rectangular geometry that are compatible with the excitation of Rydberg atomic states. Accomplishing this will require investments in cell design, bonding and fabrication techniques, sample filling process development, and quality assurance testing to verify Rydberg state excitation capability. Many existing research efforts have focused on creating compact cells, however, maintaining the capability to excite atoms to Rydberg states introduces additional constraints in the fabrication process and materials. A thin rectangular form factor with thin (<2mm) walls could allow efficient coupling of signals from planar resonant circuits or photonic integrated circuits. Such a geometry would also facilitate spatially-resolved THz imaging with Rydberg sensors over larger areas than are currently feasible without requiring the cell to be physically repositioned over the object to be imaged.

PHASE I: This topic is accepting Direct to Phase II proposals only. Documentation of existing alkali vapor cell production (though not necessarily those compatible for Rydberg-state excitation) and sales for scientific applications will be sufficient to establish feasibility. Data demonstrating the capability to measure resonant absorption of typical alkali optical spectroscopy (atomic absorption spectroscopy) in cells at the small business is preferred.

PHASE II: The project will produce 10-100 rubidium or cesium vapor cells of a high-aspect-ratio rectangular geometry to a government laboratory for testing. The cells must demonstrate over 40% room-temperature resonant absorption of probing light and support excitation to Rydberg atomic states. The walls on the long axis of the cell must be optically transparent and flat to accommodate laser beam transmission. The large-area walls (>6 cm^3) must be transparent to electromagnetic waves with frequencies of 0.1 – 3.0 terahertz (THz).

The cells will be tested by the government to determine adequate Rydberg sensor performance based on measurement of narrow unperturbed atomic resonances and transparency to agreed electromagnetic frequencies.

Optional deliverable requirements include: Minimum alkali optical thickness or vapor pressure, wall material choice (e.g. borosilicate glass with sapphire coating), optical access, window transparency and optical quality. Vapor density control that is RF transparent, waveguide and/or electrode integration, surface charge mitigation, integrated micro-optics or fiber coupled cells, aging tests. Phase II Base amount must not exceed $1,000,000 for a 12-month period of performance and the Option amount must not exceed $700,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: Creating a reliable process for filling alkali vapor cells that support Rydberg state excitation and have non-traditional geometries will have applications for quantum sensing in a variety of military and commercial spaces. Rydberg-atom electrometers are an emerging technology for creating communication receivers simultaneously operating at frequencies spanning many tens of GHz in a single device. This could have applications in the defense and commercial telecommunication industries, to include 5G technology. Rydberg-atom electrometers can also be used to calibrate antenna emissions in a way that does not perturb the radiation pattern and that is ambivalent to strong fields that could damage traditional technologies.

REFERENCES:

1. Phys. Rev. Applied 13, 054034 (2020) - Vapor-Cell-Based Atomic Electrometry for Detection Frequencies below 1 kHz (aps.org)
2. Phys. Rev. X 10, 011027 (2020) - Full-Field Terahertz Imaging at Kilohertz Frame Rates Using Atomic Vapor (aps.org)

KEYWORDS: Vapor; cell; rubidium; cesium; Rydberg; quantum; atomic; teraHertz

OSD232-006 TITLE: Low Size, Weight, and Power (SWAP), High Electrical Efficiency Microwave and/or Radiofrequency (RF) Generator or Amplifier for Atomic or Molecular Spectroscopy Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Quantum Science

OBJECTIVE: Low Size, Weight, and Power (SWaP), high electrical efficiency microwave and/or radiofrequency (RF) generator or amplifier for atomic or molecular spectroscopy applications.

DESCRIPTION: Quantum computing and quantum information science use “qubits” (quantum bits) to store information. These qubits can be implemented in many ways, frequently by manipulating the energy state of the qubit to change between two levels. For atomic, atomic ion[1,2], molecular ion, and other physical implementations of qubits, these levels can be separated by microwave-scale energy differences. For example, trapped ion qubits can have level differences ranging from 0.8 to 41 GHz (listed as hyperfine splittings in [3]). Additionally, radio frequency can be utilized with acousto-optic or electro-optic modulation to place sidebands on lasers, allowing them address additional structure within the qubits. Microwave spectroscopy is not limit to single atoms or ions, but can extend to molecular polar ions [4] where microwaves are able to identify and manipulate the rotational state of the ions.
This need places good quality microwave and radiofrequency sources and amplifiers among the critical components of many quantum information science-related experiments. In particular these devices need good amplitude, frequency, and phase noise characteristics for the final, post-amplification signal at delivered to the qubit.

While most of these experiments take place in laboratory environment, increased electrical efficiency remains important. In addition to their contributions to operating costs, electrical inefficiencies will add to the overall thermal load of the laboratory making temperature stability a greater challenge and restricting the locations of the equipment relative to temperature-sensitive equipment. Additionally, for efforts looking to transition these quantum technologies outside of pristine laboratory environments, the Size, Weight, and Power (SWaP) of these devices will limit the locations in which they can be deployed. Mobile platforms are a particular challenge due to their strict SWaP limitations; on these platforms any gain in efficiency or reduction in SWaP either allows additional capabilities to be included or enables longer time-in-service. For example (although not used for spectroscopy in this instance), microwave sources were deployed to the International Space Station as part of a ultracold atomic physics experiment package [5].

PHASE I: Phase I will determine the technical feasibility of radiofrequency and/or microwave sources and/or amplifiers, suitable for the uses described in the objective and description above. Because this topic covers a wide range of frequencies and applications, no uniform set of metrics will apply to all situations. As such, the proposer should identify one or more comparable research laboratory-grade device(s) as the benchmark for comparison during Phase I and any following Phase efforts.
A successful effort will include a detailed analysis of predicted performance, including both improvements on relevant microwave and/or radiofrequency signal metrics (e.g. linearity, gain, response flatness, phase noise, amplitude noise, frequency noise, etc.) and overall electrical efficiency of the system compared to identified performance benchmarks. Phase I Base amount must not exceed $295,000 for a 12-month period of performance.

PHASE II: Using the results from Phase I, develop, test, and demonstrate the operation of a prototype system. This should include a direct laboratory comparison to the identified benchmark system in Phase I, if feasible. Phase II Base amount must not exceed $1,300,000 for a 24-month period of performance and the Option amount must not exceed $650,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: The quantum information science industry extends well beyond DoD research settings, with many existing laboratories in DoD, academic, and private industry contexts (for example, [6] contains a listing of trapped ion research groups around the world). These laboratories have uses for microwaves beyond those considered in this SBIR, for example [7-8]. Any gains in performance under Phase I or Phase II could be utilized by any of these laboratories. Additionally, microwaves are used broadly throughout the telecommunications industry, where improvement in efficiency could provide immediate benefits to interested parties.

REFERENCES:

1. Colin D. Bruzewicz, John Chiaverini, Robert McConnell, and Jeremy M. Sage , "Trapped-ion quantum computing: Progress and challenges", Applied Physics Reviews 6, 021314 (2019) https://doi.org/10.1063/1.5088164
2. Leibfried, D., Blatt, R., Monroe, C., & Wineland, D. (2003). Quantum dynamics of single trapped ions. Reviews of Modern Physics, 75(1), 281–324. doi:10.1103/RevModPhys.75.281
3. Quantum Computing with Trapped Ions, Duke University. (2023). Trapped Ion Periodic Table. Retrieved March 10, 2023, from https://iontrap.duke.edu/resources/ion-periodic-table/
4. Shi, M., Herskind, P. F., Drewsen, M., & Chuang, I. L. (2013). Microwave quantum logic spectroscopy and control of molecular ions. New Journal of Physics, 15(11), 113019. doi:10.1088/1367-2630/15/11/113019
5. Frye, K., Abend, S., Bartosch, W. et al. The Bose-Einstein Condensate and Cold Atom Laboratory. EPJ Quantum Technol. 8, 1 (2021). https://doi.org/10.1140/epjqt/s40507-020-00090-8
6. Air Force Research Laboratory, Quantum Information Science Branch. (2022). AFRL/RITQ - ion references and useful links. AFRL/RITQ - Ion References and Useful Links. Retrieved March 10, 2023, from https://www.afrl.af.mil/About-Us/Fact-Sheets/Fact-Sheet-Display/Article/3040329/afrlritq-ion-references-and-useful-links/
7. Lekitsch, B., Weidt, S., Fowler, A. G., Mølmer, K., Devitt, S. J., Wunderlich, C., & Hensinger, W. K. (2017). Blueprint for a microwave trapped ion quantum computer. Science Advances, 3(2), e1601540. doi:10.1126/sciadv.1601540
8. Piltz, C., Sriarunothai, T., Ivanov, S. S., Wölk, S., & Wunderlich, C. (2016). Versatile microwave-driven trapped ion spin system for quantum information processing. Science Advances, 2(7), e1600093. doi:10.1126/sciadv.1600093

KEYWORDS: Microwave Oscillators; Microwave Amplifiers; Radio Frequency Generators; Radio Frequency Amplifiers; Radio Frequency Spectroscopy; Atomic Spectroscopy; Molecular Spectroscopy; Quantum Information

OSD232-D07 TITLE: Robust Resonant rf Circuit for Trapped Ion Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Quantum Science

OBJECTIVE: This program seeks to develop a stable, resonant rf circuit for trapped ion systems that is resistant to environmental perturbations such as ambient temperature changes and vibration.

DESCRIPTION: Isolated, trapped atomic ions are among the leading candidates to realize quantum computing and quantum networking systems. Trapped ions are confined using high voltage rf electric fields to isolate the ions from the external environment. The confining potential determines the normal mode frequencies of vibration of a chain of trapped ions; typical rf resonant circuits (Q = 200 – 500) apply a single frequency in the 10 – 100 MHz range with an rf amplitude of approximately 250 – 500 volts, depending on the ion trap. Stabilizing the trapped ion normal mode frequencies, proportional to the ratio of the applied voltage to the rf drive frequency, can play a key role in enabling high-fidelity entangling gates between trapped ions while allowing higher speed entangling gates. Using active feedback, these circuits have been stabilized to approximately 10 ppm in a pristine, laboratory setting with small variations in temperature and minimal vibration [1].

PHASE I: This topic is accepting Direct to Phase II proposals only. The proposer must provide a report or documentation showing the feasibility of the proposed approach. Such a report could be based on measured performance of an early prototype device (whether connected to an ion-trap stand-in load or an ion trap). If iterating on an existing design with measured performance lower than the specifications below, offeror should identify the key design changes leading to the expected improvement in performance, along with applicable simulation and/or modeling. For new designs, the approach should be documented with simulations and/or modeling showing the expected performance for the proposed design.

PHASE II: This project will develop a laboratory prototype device (not necessarily a quarter wave helical resonator) that results in an applied rf field to an ion trap where a trapped ion's secular frequency should be stable. To accomplish this, the ratio of the rf voltage amplitude to the drive frequency should vary by less than 1 x 10^-5 if the ambient air temperature varies by +/- 3 C. This stability should also be maintained if the device is subjected to acoustic noise in the audio range at levels of approximately 60 dB. The resonator shall be tested by measuring the stability of an ion trap's transverse secular frequency. The measurement should be performed optically by probing an ion sideband of motion probing a narrow transition (ex: Raman or quadrupole) to enable the required precision for characterizing the resonator performance. This measurement can be done in-house or by external partnership. In addition, a final report detailing the design and testing should be made available. This report could take the form of a publication if appropriate. Phase II Base amount must not exceed $700,000 for a 12-month period of performance and the Option amount must not exceed $300,000 for a 6-month period of performance.

PHASE III DUAL USE APPLICATIONS: Phase III potential applications: This rf resonator circuit with enhanced resistance to environmental perturbations can be commercialized and used on commercial trapped ion systems as well as DoD trapped ion systems. The development of trapped ion systems is aligned with DoD goals to develop quantum information technology to enhance position, navigation, timing, and secure communication. Generally, this technology could be used where there is a need to supply high voltage at radiofrequencies to a low impedance electrical load.

REFERENCES:
1. "Active Stabilization of Ion Trap Radiofrequency Potentials," K. G. Johnson, J. D. Wong-Campos, A. Restelli, K. A. Landsman, B. Neyenhuis, J. Mizrahi, and C. Monroe, Rev. Sci. Instrum. 87, 053110 (2016); arXiv:1603.05492v2

2. “Electromagnetic traps for charged and neutral particles”, W. Paul, Rev. Mod. Phys, 62, 531,(1990).
3. “Realization of a Filter with Helical Components”, A. I. Zverev and H. J. Blinchikoff, IRE Trans. Compon. Parts, 99 (1961).
4. “Coaxial Resonators with Helical Inner Conductor,” W. W. MacAlpine and R. O. Schildknecht, Proc. IRE, 2099 (1959).
5. Siverns, J.D., Simkins, L.R., Weidt, S. et al. On the application of radio frequency voltages to ion traps via helical resonators. Appl. Phys. B 107, 921–934 (2012).; arXiv:1106.5013v3

KEYWORDS: Ion trap; entanglement; quantum gates; rf resonator; high-fidelity; quantum computing; quantum network

OSD232-008 TITLE: Efficient, Scalable, and Robust Techniques for Interconnecting Optical Fibers and Photonic Integrated Circuit Waveguides at Milli-Kelvin Temperature

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Sensing and Cyber; Integrated Network Systems-of-Systems

OBJECTIVE: To develop techniques for efficient, reliable, and extensible routing of light from ambient conditions through optical fibers to quantum photonic integrated circuit waveguides at milli-Kelvin temperature.

DESCRIPTION: Future quantum information networks will enable new capabilities for the DoD in regard to secure communications, information processing, sensing, positioning, navigation and timing. To achieve such functionality, these networks will require heterogeneous node technology, with different quantum technologies serving different functions – e.g. memory, processor, sensor, transceiver, and transducer devices. Accordingly, to realize such functionality efficient quantum interfaces must be developed between different qubit modalities, including technologies that work in the microwave domain and ones that primarily work at optical frequencies. As well, because microwave-regime quantum technologies (like superconducting and semiconducting qubits and quantum sensors), generally must be operated at cryogenic temperatures, efficient quantum interconnects between microwave and optical frequencies must be able to satisfy the engineering demands that derive from thermal gradients, heat loads, signal attenuation, and thermal cycling between ambient conditions and Kelvin and milli-Kelvin temperatures. A particularly critical and outstanding requirement in this regard is the engineering of efficient, reliable, and scalable (i.e. high density) interconnects between optical fibers and quantum integrated photonic circuit (QPIC) waveguides, transducers, detectors, and other QPIC elements that remain robust (i.e. continue to achieve key performance parameters) in the presence of differential thermal contraction and other variations due to temperature dependent materials parameters of optical fibers, adjoining media, and QPICs. Among other considerations, this requirement is essential for coherent quantum state transduction and heralded entanglement between cryogenic quantum processors on physically separated cryostats, efficient routing of light to superconducting photon sensors, and high throughput i/o data channels for classical electro-optical cryogenic signal routing and processing. In light of this, the call for proposals is seeking innovative technologies and/or processes thar will advance the development of low-loss cryogenic fiber interconnects to QPICs.

The main objective is to obtain sub-dB coupling loss per connection to temperatures as low as 10 milli-Kelvin, typical of standard commercially available dilution refrigerators, with low-loss performance maintained over hundreds of thermal cycles. Moreover, the techniques should be compatible with a modular and extensible milli-kelvin platform, which entails the follow characteristics: small form factor, readily enabling installation of multi-converter units in a single cryostat; minimal need for tuning of interconnects after cool-down from ambient conditions (no tuning is the ideal target to achieve); and compatibility with state-of-the-art superconducting and semiconductor qubits and sensors for chip-level microwave-optical integration. While these techniques or processes may be at low technology readiness levels (e.g. TRL 3) by the end of Phase I, it is expected that a pathway to TRL maturation will be achieved through Phase II, with the potential for integration with heterogeneous quantum entanglement distribution testbeds in Phase III.

PHASE I: Validate the product-market fit between the proposed solution and the proposed topic and define a clear and immediately actionable plan for running a trial with the proposed solution and the proposed AF customer. This feasibility study should:

1. Clearly identify who the prime (and additional) potential end user (e.g. Air Force, Army, etc.) is and articulate how they would use your solutions (i.e., the one who is most likely to be an early adopter, first user, and initial transition partner).

2. Deeply explore the problem or benefit areas, which are to be addressed by the solutions - specifically focusing on how this solution will impact the end user of the solution.
3. Define clear objectives and measurable key results for a potential trial of the proposed solution with the identified end users.
4. Clearly identify any additional specific stakeholders beyond the end users who will be critical to the success of any potential trial. This includes, but is not limited to, program offices, contracting offices, finance offices, information security offices and environmental protection offices.
5. Describe the cost and feasibility of integration with current mission-specific products.
6. Describe if and how the demonstration can be used by other DoD or governmental customers.
7. Describe technology related development that is required to successfully field the solution.
8. The funds obligated on the resulting Phase I STTR/SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments, laboratory studies, commercial research and interviews. Prototypes may be developed with STTR/SBIR funds during Phase I studies to better address the risks and potential payoffs in innovative technologies.

Phase I Base amount must not exceed $295,000 for a 12-month period of performance.

PHASE II: Develop, integrate, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study. This demonstration should focus specifically on:

1. Evaluating the proposed solution against the objectives and measurable key results as defined in the Phase I feasibility study.
2. Describing in detail how the solution can be scaled to be adopted widely (i.e. how can it be modified for scale).
3. A clear transition path for the proposed solution that takes into account input from all affected stakeholders including but not limited to: end users, engineering, sustainment, contracting, finance, legal, and cyber security.
4. Specific details about how the solution can integrate with other current and potential future solutions.
5. How the solution can be sustainable (i.e. supportability).
6. Clearly identify other specific DoD or governmental customers who want to use the solution.

Phase II Base amount must not exceed $1,130,000 for a 24-month period of performance and the Option amount must not exceed $840,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: Advancements of this technology would be of direct relevance to the DoD for construction and operation of heterogeneous quantum networking testbeds for studying the use of entanglement distribution for new capabilities in secure communications, information processing, sensing, positioning, navigation and timing. It would also have direct relevance to industry, including providing efficient means for the scaling of existing cryogenic components of commercial quantum processors.

REFERENCES:

1. United States Air Force 2030 Science and Technology Strategy: Strengthening USAF Science and Technology for 2030 and Beyond. https://www.af.mil/Portals/1/documents/2019%20SAF%20story%20attachments/Air%20Force%20Science%20and%20Technology%20Strategy.pdf
2. A Coordinate Approach to Quantum Networking Research https://www.quantum.gov/wp-content/uploads/2021/01/A-Coordinated-Approach-to-Quantum-Networking.pdf

3. Defense Science Board. Applications of Quantum Technologies https://dsb.cto.mil/reports/2010s/DSB_QuantumTechnologies_Executive%20Summary_10.23.2019_SR.pdf

KEYWORDS: Quantum communication; quantum information processing; quantum interconnects; transduction; quantum photonic integrated circuits; QPICS; superconducting qubits; superconducting sensors

OSD232-009 TITLE: Application-specific Electronic Package for a Quantum Sensor

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics; Quantum Science

OBJECTIVE: An application-specific electronics package that enables low-noise miniaturization of quantum systems.

DESCRIPTION: Quantum systems rely on electronics for control and signal input/output to larger systems. Often, these originate with large scale lab electronics, then are scaled down to field programmable gate arrays (FPGA) to enable modularity. However, FPGAs can be large, expensive, power hungry, and potentially introduce unknown and undesired threats. Application-specific electronics can be one approach to overcoming the limitations of an FPGA. Application specific electronics can include, but are not limited to, custom printed circuit board design or application-specific integrated circuit (ASIC) development. An ASIC is the smallest SWaP and typically lowest noise solution but has a high barrier to entry as it includes high non-recurring engineering costs and long wait times, due to the business model of IC foundries. This SBIR topic aims to lower the investment required by small businesses to creating custom, specific electronics and packaging for quantum sensors, in order to increase TRL and the ability to bring small quantum sensors to market.

PHASE I: Use of IC foundries can be arduous and include long lead times. Phase I of the topic should include design of the application specific electronics, identifying and negotiating with a trusted IC foundry for fabrication, and receiving the process design kit (PDK) from the foundry of choice. The outcome of Phase I should be that the performer is ready to move forward to procure an ASIC with a foundry, either with dedicated wafers or as part of a multi-project wafer (MPW) run.

Alternatively, Phase 1 can be to develop application specific, custom electronics on a printed circuit board. The product of Phase I is a detailed report outlining the design, including modeling and simulation, and a detailed plan for fabrication. One key component for this critical technology, will be to consider the ‘trust’ of the vendor. The Phase I deliverable should outline the risk management and quality assurance of safeguarding against any IP threats. Phase I Base amount must not exceed $290,000 for a 12-month period of performance.

PHASE II: The Phase II goal of the SBIR is to integrate and demonstrate the custom electronics packaged with and operating with the quantum sensor of choice. The Phase II deliverable is a report outlining the electronics design and fabrication, as well as integration tests and demonstration results. Ideally, the custom electronics integrated with a quantum sensor will become a government off-the-shelf component for procurement. The custom, packaged electronics should dramatically reduce cost, size, weight and power necessary for operating quantum sensors, thereby creating a viable transition path to the warfighter. Phase II Base amount must not exceed $1,000,000 for a 24-month period of performance and the Option amount must not exceed $900,000 for a 12-month period of performance.

PHASE III DUAL USE APPLICATIONS: One military application would be to create the custom electronics necessary for a quantum-based clock, such as a photonic integrated chip that requires IC fabrication for photonics and electronics. The product to be included with the quantum clock, would require packaging. Alternatively, there are chip-scale quantum sensors, such as SQUID arrays that require custom electronics packaging and electronic interfaces. This SBIR topic covers the electronics design, fabrication, and packaging for this class of EM sensor.

REFERENCES: Charbon, E. Cryo-CMOS Electronics For Quantum Computing: Bringing Classical Electronics Closer To Qubits In Space And Temperature. IEEE Solid-State Circuits Magazine 13, 54–68 (2021).

KEYWORDS: Quantum; atomic; asic; low-swap; quantum sensor; packaging

VERSION 2

UNITED STATES SPECIAL OPERATIONS COMMAND
23.2 Small Business Innovation Research (SBIR)
Phase I Proposal Submission Instructions

Join us for a virtual Q&A with our Technical Point of Contact
26 April 2023: SOCOM232-002 at 09:00 & SOCOM232-003 at 10:00 EDT

INTRODUCTION

The United States Special Operations Command (USSOCOM) seeks small businesses with strong research and development capabilities to pursue and commercialize technologies needed by Special Operations Forces through the Department of Defense (DoD) SBIR 23.2 Program Broad Agency Announcement (BAA).

Offerors responding to a topic in this BAA must follow all general instructions provided in the DoD SBIR Program BAA. USSOCOM requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

The Offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of these instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

The USSOCOM SBIR/STTR Program Office will be hosting a virtual USSOCOM Industry Day on 26 May 2023 to further specify requirements and stimulate small business/research institute partnership-building. Please visit https://events.sofwerx.org/sbir23-2_sttr23-b/ **to register.**

PHASE I PROPOSAL GUIDELINES

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Offerors are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

Proposal Volumes are key in the qualification of the proposal. Offerors shall complete each of the following volumes: (1) Cover Sheet, (2) Technical Volume, (3) Cost Volume, (4) Company Commercialization Report, (5) Pitch Day Presentation, and (6) Fraud, Waste and Abuse Training.

Please Note:

1. It is the Offeror's responsibility to make sure all DoD and USSOCOM instructions are followed, and all required documents are submitted. The DSIP (DoD's SBIR/STTR proposal submission website)

does NOT ensure your submission is in accordance with both DoD and USSOCOM instructions. The DSIP notice "100% submitted" means that the upload process is complete; It does NOT mean the proposal submission complies with the stated instructions and that all required documentation is successfully uploaded.

2. USSOCOM does not assist Offerors with proposal preparation nor does USSOCOM review proposals for completeness. We recommend you use your local and state resources for assistance. (See DoD Program BAA for resources information.)
3. USSOCOM has encountered issues while downloading proposals due to lengthy file names. The Offeror shall not use more than 20 characters to include spaces in any of the proposal documents titles.
4. **USSOCOM does NOT require a Government Letter of Support (LoS). Any Government LoS provided will deem the proposal to be non-responsive (Disqualified).**

Cover Page (Volume 1)
Volume 1 is created as part of the DoD Proposal Submissions process. Follow all instructions provided in the DoD SBIR Program BAA and DSIP.

Technical Volume (Volume 2)
The Technical Volume is not to exceed (5) pages and must follow the formatting requirements provided in the DoD SBIR Program BAA titled, "DoD SBIR 23.2 Program BAA". USSOCOM will only evaluate the first (5) pages of the Technical Volume, additional pages will not be considered or evaluated.

Content of the Technical Volume:
Required items are specified in the DoD SBIR Program BAA Phase I Format of Technical Volume instructions, reference https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/ then scroll to the bottom of the page and click on the tab titled "Supporting Documents and Attachments". At the bottom of the list, select the document titled "Phase I Technical (Vol 2) Sample Template".

Contract Data Requirement Lists (CDRLs): CDRLs identify which data products must be delivered by the contractor to the Government. Please make sure you read all required CDRLs requirements (each using a DD Form 1423-1) prior to developing your proposal. All five of the required Phase I CDRLs are available on https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.

Cost Volume (Volume 3)
The Phase I amount must not exceed $175,000. Costs must be identified on the Proposal Cover Sheet (Volume 1) and in Volume 3. Once the proposal is established in DSIP the Offeror will have access to the required USSOCOM specific Cost Volume instructions and template.

A minimum of 67% of the research and/or analytical work in Phase I must be conducted by the proposing firm. The percentage of work is measured by both direct and indirect costs as a percentage of the total contract cost.

Please review the updated Percentage of Work (POW) calculation details included in section 5.3 of the DoD Program BAA. USSOCOM will not accept any deviation to the POW requirements on these Phase I topics.

The cost volume template (volume 3 template) is located on DSIP and https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.

The identification of foreign national involvement in a USSOCOM SBIR topic is needed to determine if a firm is ineligible for award on a USSOCOM topic that falls within the parameters of the United States Munitions List, Part 121 in the International Traffic in Arms Regulation (ITAR). A firm employing a foreign national(s) (as defined section titled "Foreign Nationals" of the DoD SBIR Program BAA) to work on a USSOCOM ITAR topic must possess an export license to receive a SBIR Phase I contract.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by USSOCOM during proposal evaluations.

Supporting Documents (Volume 5)
In addition to the documentation outlined in the DoD SBIR Program BAA, the following USSOCOM required documents must be included with Volume 5: (1) PowerPoint presentation, (2) Section K, and (3) Resumes.

1. PowerPoint Presentation: Potential Offerors shall submit a slide deck **not to exceed 15 PowerPoint slides** (inclusive of the cover sheet). The presentation shall not have any videos or links to videos. There is no set format for this document. It is recommended (but not required) that more detailed information is included in the technical volume and higher-level information be included in the slide deck, suitable for a possible presentation. Refer to the "Phase I Evaluations" Section of this instruction for more details.
2. Section K - Titled "Representations, Certifications, and other statements of Offerors": If Section K is not submitted with the proposal, the proposal will still be considered responsive, but the completed Section K shall be required at the time of award. Section K is available at https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.
3. Resumes: Include resumes.

Fraud, Waste and Abuse Training (Volume 6)
Fraud, Waste and Abuse (FWA) training is required for Phase I proposals. Please refer to the DoD SBIR Program BAA instructions for full details.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA): USSOCOM does not provide Discretionary Technical and Business Assistance for Phase I awards.

INQUIRIES:
USSOCOM does not allow direct communication with the topic authors (differs from the DoD SBIR/STTR Program BAA instructions).

During the Pre-Release and Open Periods of the DoD SBIR Program BAA, only and all technical questions that enhance the Offerors understanding of the topic's requirements must be submitted to the online Defense SBIR/STTR Innovation Portal (DSIP) Topic Q&A. All questions and answers submitted to DSIP Topic Q&A will be released to the general public.

USSOCOM does NOT allow inquirers to communicate directly in any manner to the topic authors (differs from the DoD STTR Program BAA instructions). Only questions pertaining to the proposal preparation instructions should be directed to: sbir@socom.mil. All inquiries must include the topic number in the subject line of the e-mail.

Consistent with DoD SBIR instructions, USSOCOM will not answer programmatic questions, such as who the technical point of contact is, the number of contracts to be awarded, the source of funding, transition strategy.

Physical site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR Program BAA.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA, with the following exceptions:

1. Proposals missing any of the six stated volumes, or those that do not comply with the requirement of the percentage of work (67%) to be executed by the proposing firm, or those proposals that exceed the maximum price allowed as per Table 1 of these instructions, will be considered non-responsive. Non-responsive proposals will not be evaluated.
2. The technical evaluation will utilize the Evaluation Criteria provided in DoD SBIR Program BAA instructions. The Technical Volume and PowerPoint Presentation slide deck will be reviewed holistically.

   The technical evaluation is performed in two parts:

   Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in the DoD SBIR Program BAA. Once the evaluations are complete, all Offerors will be notified in a timely manner.
   Part II: Selected offerors **may** receive an invitation to present their slide deck (30-minute presentation time/30-minute Government question and answer period) to the USSOCOM technical evaluation team, using virtual teleconference. This will be a technical presentation of the proposed solution **ONLY**. The key personnel listed in the proposal should represent the presentation and responding to the questions of the evaluation team. This presentation is NOT intended for business development personnel, it is purely technical. Selected offerors shall restrict their Pitch Day presentations to the 15-page PowerPoint presentation submitted with the respective proposals. There will be no changes or updates to the presentations from what was proposed. This presentation will complete the evaluation of the proposal against the criteria listed in the DoD SBIR Program BAA.

3. The Cost Volume (Volume 3) evaluation:
   For this Phase I, the award amount is set at a not to exceed (NTE) amount and a technical evaluation of the proposal cost will be completed to assess price fair and reasonableness. The team will assess the technical approach presented for the effort based on the number of labor hours by labor categories, the key personnel level of involvement, materials, subcontractors, and consultants (scope of work, expertise, participation, and proposed effort), and other direct cost as proposed.

Additionally, input on technical aspects of the proposals may be solicited by USSOCOM from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements. When appropriate, non-government advisors may have access to Offeror's proposals and may be utilized to objectively review a proposal in a particular functional area and provide comments and recommendations to the Government's decision makers. They may not establish final assessments of risk, or rate or rank Offerors' proposals. All advisors shall comply with procurement Integrity Laws and shall sign Non-Disclosure and Rules of Conduct/ Conflict of Interest statements. The Government shall take into consideration requirements for avoiding conflicts of interest. Submission of a proposal in response to this request constitutes approval to release the proposal to Government support contractors.

Offerors will be notified of selection or non-selection status for a Phase I award within 90 calendar days of the closing date of the BAA by the USSOCOM Contracting Office. This notification will come by e-mail to the Corporate Official identified by the Offeror during proposal submission. The Government will also notify the Offerors if their proposal is considered non-responsive (disqualified).

A non-selected Offeror can make a written request to the Contracting Officer, within 30 calendar days of receipt of notification of non-selection, for informal feedback. The Contracting Officer will provide informal feedback after receipt of an Offeror's written request rather than a debriefing as specified in the DoD SBIR Program BAA instructions.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: sbir@socom.mil.

PATH TO PHASE II
Phase II proposals may only be submitted by Phase I awardees. In the event that the Phase II of a topic is cancelled, Phase I awardees will be informed by USSOCOM and Phase II proposals will not be accepted. To obtain the Phase II requirements, refer to the Contract Data Requirements List (CDRL) A004. The Final Report will be due on or before 6 months of the start of the Period of Performance (PoP) In Accordance With (IAW) CDRL A003. Your Phase II proposal will be due on or before the 195th day of the start of the PoP IAW CDRL A005.

All CDRLs are available on https://www.socom.mil/SOF-ATL/Pages/sbir.aspx. There are two different attachments for CDRL 5. Please refer to the section titled "Award and Contract Information" for the contracting path pertaining to the topic.

The Government reserves the right to issue any of the following type of awards for Phase II:

1. FAR type contract
2. Non-FAR based fixed price (level of effort type):
    a. Other Transactions Agreements (OTA). Successful completion of the prototype under an OTA may result in a follow-on production OTA or contract. Successful completion of the prototype is defined as meeting one or more threshold requirements.
    b. USSOCOM may use a partnership intermediary to award SBIR/STTR contracts and agreements to small business concerns. This may be done through USSOCOM's intermediary partner, SOFWERX (www.SOFWERX.org) resulting in a commercial contract between the firm and DEFENSEWERX. The is authorized by the National Defense Authorization Act (NDAA) for Fiscal Year 2022, Section 852, MODIFICATION OF PILOT PROGRAM FOR DEVELOPMENT OF TECHNOLOGY- ENHANCED CAPABILITIES WITH

PARTNERSHIP INTERMEDIARIES. The Government will conduct the evaluation and select the proposals to be funded for award.

VERSION 2

AWARD AND CONTRACT INFORMATION

Table 1: Consolidated SBIR Topic Information

Topic	Technical Volume (Vol 2)	Additional Info. (Vol 5)	Period of Performance	Award Amount	Contract Type
Phase I SOCOM232-002	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 7 months	NTE \$175,000.00	Firm-Fixed-Price
Phase I SOCOM232-003	Not to exceed 5 pages	15 page PowerPoint	Not to exceed 7 months	NTE \$175,000.00	Firm-Fixed-Price

The Government will conduct evaluations and selections for SBIR Phase I topic award(s) listed in this BAA. SOCOM232-002 and 232-003 awards will be made by USSOCOM SBIR Contracting Officer.

ADDITIONAL INFORMATION

Phase I proposals shall NOT include:

1) Any travel for Government meetings. All meetings with the Government will be conducted via electronic media.
2) Government furnished property or equipment.
3) Priced or Unpriced Options.
4) “Basic Research” (or “Fundamental Research”) defined as a “Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind.”
5) Human or animal studies.
6) Discretionary Technical and Business Assistance (TABA)
7) Letters of Support

VERSION 2

SOCOM SBIR 23.2 Phase I Topic Index

VERSION 2

SOCOM232-002 TITLE: Hokkien Low Density Language System

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Trusted AI and Autonomy; Advanced Computing and Software; Integrated Network Systems-of-Systems;

OBJECTIVE: The objective of this topic is to develop applied research toward an innovative capability to allow US SOF to communicate effectively with the Partner Forces in many Low Density Languages starting with Taiwan Hokkien. The develop a Low Density Language development, for the Taiwan Hokkien Language, is a Voice to Voice communication capability that is 100% disconnected from the cloud in a portable form factor.

IMPORTANT: For SOCOM instructions: please visit: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/. Go to the bottom of the page and click the “DoD SBIR 23.2” tab. Once there, go to the SOCOM SBIR 23.2 document.

DESCRIPTION: As other High Density Languages are being developed, there is a need to develop a Low Density Language Capability. The start point for these LDL’s is Taiwan Hokkien. As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications as this solution may be incorporated into the current model or could be a standalone option.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled “Objective” and “Description.”
The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study (“Technology Readiness Level 3”) to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on a handheld, zero cloud, Fluent Taiwan Hokkien capability. The responsible program office uses the Defense Language Institute’s (DLI) Defense Language Proficiency Test (DLPT) Rating System with 3 Levels as established by the International Language Roundtable (ILR). Level 1 roughly equates to basic proficiency, Level 2 is conversational proficiency and Level 3 is Professional Proficiency.

VERSION 2

PHASE III DUAL USE APPLICATIONS: This technology could be used by All DOD and Civilian Support to translate lost languages utilizing the principle of machine learning. AI can use statistical models to correlate words in one language with words in another. This technology can handle vast amounts of content very quickly to aid communications with other countries to help bridge the gap in understanding one another.

REFERENCES:

1. Conversational demonstration of ILR DLI DLPT Levels: http://vimeo.com/showcase/139578; History of the process: https://govtilr.org/Skills/IRL%20Scale%20History.htm

KEYWORDS: Language; Translation; Device, Software, Taiwan, Hokkien, Low Density Language

VERSION 2

SOCOM232-003 TITLE: Higher Density Handheld Radio Batteries

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Renewable Energy Generation and Storage; Advanced Materials

OBJECTIVE: The objective of this topic is to develop applied research towards higher density handheld radio batteries. To meet evolving radio systems that require additional power to provide new capabilities, the demand for increased battery capacity has exponentially grown. Operators also require batteries that meet capacity to reduce the number of times that they switch batteries during missions and reducing the weight of carried items during missions.

IMPORTANT: For SOCOM instructions: please visit: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/. Go to the bottom of the page and click the "DoD SBIR 23.2" tab. Once there, go to the SOCOM SBIR 23.2 document.

DESCRIPTION: As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications on the key system attributes below:

- Battery Capacity equal to or greater than 16 Ah (Amp Hours in a .84-pound battery). This is equivalent to approximately 500 Wh/kg (watt-hour per kilogram) (500 Wh/Kg / 12volts / 2.2lbs/kg x .84BatteryWeightInPounds = 15.909Ah)
- Battery shall have >70% of its nominal capacity after 300 full discharge / discharge cycles
- Battery shall provide 12VDC (volts direct current) for handheld radio operations
- Battery shall not exceed .84 pounds in weight
- Battery shall not exceed 15.232 cubic inches (3.4 x 2.8 x 1.6) – current battery volume
- Battery shall support Peak Current => 8A (Amps)

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled "Objective" and "Description."

The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study ("Technology Readiness Level 3") to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

VERSION 2

PHASE II: Develop, install, and demonstrate prototype batteries determined to be the most feasible solution during the Phase I feasibility study on a Higher Density Handheld Radio Battery.

PHASE III DUAL USE APPLICATIONS: These batteries can be used by multiple organizations that use handheld radios (standard connection) and the technology should transition to other battery systems with limited development.

REFERENCES:

Illinois Institute of Technology. (2023, February 2). The novel chemistry behind ultra-high power density batteries. https://techxplore.com/news/2023-02-chemistry-ultra-high-power-density-batteries.html; Designing better batteries for electric vehicles. (2021, August 16). MIT News | Massachusetts Institute of Technology. https://news.mit.edu/2021/designing-better-batteries-electric-vehicles-0816; A Guide to Understanding Battery Specifications (2008, December). MIT Electric Vehicle Team. http://web.mit.edu/evt/summary_battery_specifications.pdf

Battery Examples:

Bren-Tronics, Inc. BT-70716Bx Series Battery https://www.bren-tronics.com/amfile/file/download/file/449/product/1947; AN/PRC-148 Battery https://www.bren-tronics.com/amfile/file/download/file/244/product/1949/; AN/PRC-163 Battery https://www.epsilor.com/product/prc-152-prc-163/battery-for-prc-152-radios-eli-152/

KEYWORDS: Battery; density; radio; handheld; amp hour

VERSION 3

UNITED STATES SPECIAL OPERATIONS COMMAND
23.2 Small Business Innovation Research (SBIR)
Direct to Phase II Proposal Submission Instructions

Join us for a virtual Q&A with our Technical Point of Contact
26 April 2023: SOCOM232-D004 at 11:00 EDT

INTRODUCTION

The United States Special Operations Command (USSOCOM) 23.2 Direct to Phase II (DPII) proposal submission instructions cover DPII proposals only and change/append the Department of Defense (DoD) instructions for Phase II submissions as they apply to USSOCOM Direct to Phase II requirements. The Government will only evaluate responsive proposals.

USSOCOM seeks small businesses with strong research and development capabilities to pursue and commercialize technologies needed by Special Operations Forces (SOF) through the Department of Defense (DoD) SBIR 23.2 Program Broad Agency Announcement (BAA).

Offerors responding to a topic in this BAA must follow all general instructions provided in the DoD SBIR Program BAA. USSOCOM requirements in addition to or deviating from the DoD Program BAA are provided in the instructions below.

Proposers are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic and contractual changes.

- The DoD Program BAA is located at: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements. Be sure to select the tab for the appropriate BAA cycle.
- Register for the DSIP Listserv at: https://www.dodsbirsttr.mil/submissions/login.

The Offeror is responsible for ensuring that their proposal complies with the requirements in the most current version of these instructions. Prior to submitting your proposal, please review the latest version of these instructions as they are subject to change before the submission deadline.

The Government may withdraw from negotiations at any time for any reason to include matters of national security (foreign persons, foreign influence or ownership, inability to clear the firm or personnel for security clearances, or other related issues).

The USSOCOM SBIR/STTR Program Office will be hosting a virtual USSOCOM Industry Day on 26 May 2023 to further specify requirements and stimulate small business/research institute partnership-building. Please visit https://events.sofwerx.org/sbir23-2_sttr23-b/ to register.

DIRECT TO PHASE II PROPOSAL GUIDELINES

The topics below are accepting Direct to Phase II (DPII) proposals only.

Offerors interested in submitting a DPII proposal must provide documentation to substantiate that the scientific and technical merit and feasibility of the objectives described in the Phase I section of the topic have been met and the potential commercial applications. 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 performed and be owned (data rights) by the offeror and/or the Principal Investigator.

USSOCOM will not evaluate the offeror's related DPII proposal if the offeror fails to demonstrate technical merit and feasibility of the proposed solution has been established, or the offeror has failed to demonstrate that work submitted in the feasibility documentation was performed by the offeror and/or the PI.

The Defense SBIR/STTR Innovation Portal (DSIP) is the official portal for DoD SBIR/STTR proposal submission. Offerors are required to submit proposals via DSIP; proposals submitted by any other means will be disregarded. Detailed instructions regarding registration and proposal submission via DSIP are provided in the DoD SBIR Program BAA.

USSOCOM does not provide Discretionary Technical and Business Assistance for Direct to Phase II awards.

Please Note:

1. It is the offeror's responsibility to make sure all DoD and USSOCOM instructions are followed, and proper documentations are submitted. The DSIP (DoD's SBIR/STTR proposal submission website) will NOT be able to ensure your submission is in accordance with both DoD and USSOCOM instructions. The DSIP "100% submitted" means that the upload process is complete; It does NOT mean the proposal submission is in compliance with the stated instructions and that all required documentation is successfully uploaded.

2. USSOCOM doesn't assist offerors with proposal preparation or review of proposals for completeness. We recommend you use your local and state resources for assistance. (See DoD Program BAA for resources information.)

3. We have encountered issues while downloading proposals document titles, due to lengthy file names. **The contractor shall not use more than 20 characters to include spaces in any of the proposal documents titles.**

Cover Page (Volume 1) is created as part of the DoD Proposal Submissions process.

Technical Volume (Volume 2)
The technical volume is not to exceed 10 pages and must follow the formatting requirements provided in the DoD SBIR Program BAA instructions. Any additional pages will be deleted from the proposal prior to evaluation, only the first 10 pages will be evaluated.

Content of the Technical Volume
Direct to Phase II Technical Volume (Volume 2) instructions are the same as the Phase I DoD SBIR Program BAA Technical Volume instructions. Reference section of the DoD SBIR Program BAA titled "Content of the Technical (Volume 2)", which can be located/accessed at https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities#announcements under Current Funding Opportunities.

The Statement of Objective (SOO), with the list of Contract Data Requirement List (CDRL)s are provided and can be downloaded from https://www.socom.mil/SOF-ATL/Pages/sbir.aspx. The technical proposal shall include a non-proprietary Statement of Work (SOW) with the planned tasks and descriptions to meet the Statement of Objectives (SOO) goals detailed. Do not upload the whole SOO as your SOW with your proposal. The SOO and CDRL are provided to help the offerors consider the required goals, scope, and deliverables when developing the proposal. It is the offeror's responsibility to provide fully responsive, complete, and clear submissions. Exceptions to the requirements need to be identified/explained.

If an offeror is selected for award, the offeror will be required to submit a separate non-proprietary SOW with the planned tasks and descriptions from the proposal and all other applicable sections of the SOO and it shall include no proprietary information, data, or marking. The provided SOW will become Attachment 3 of the resulting OTA, incorporating any agreed upon changes if necessary.

Note: The Phase I Feasibility Appendix (Appendix A), documenting the results of the offeror's internal Feasibility Study, is required for the Direct to Phase II proposal and is specified in Volume 5 of these instructions.

Cost Volume (Volume 3)

Offerors must read the instructions before completing the cost volume. The Phase II Cost Volume template is posted on the USSOCOM Portal at https://www.socom.mil/SOF-ATL/Pages/sbir.aspx.

For the Direct to Phase II topics in this announcement, the total price limit to provide a testable prototype is listed in Table 1 titled "Consolidated SBIR Topic Information". **Any proposal submitted with a total price above the provided limit will not be evaluated or considered for award.**

The final price of a USSOCOM Phase II SBIR contract/Other Transaction Agreement (OTA) will be negotiated as necessary to reach a determination of price fairness and reasonableness commensurate with the magnitude and complexity of the required research and development effort. The resulting agreement will be a firm priced agreement.

Proposal information should include the itemized listing (a-h) specified below. The proposal information must include a level of detail that would enable the Government personnel to determine the purpose, necessity, and reasonableness of the proposal and show an understanding of the scope of the work. It is requested that a breakdown of labor hours per labor category and other associated costs be provided **by task.** The Agreements Officer may request additional information to support price analysis or understand the approach if needed.

a) Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the Government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment. The reason for the requirement and the intention of offeror on disposition of the special material/equipment shall be documented in the proposal as well as the reason on why said equipment is charged directly to the effort rather than in the indirect cost of the business.

b) Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list that includes item description, part number, quantities, and price.

c) Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, and costs incurred in obtaining temporary use of specialized equipment. Proposals that include leased hardware must provide an adequate lease vs. purchase justification or rationale.

d) Direct Labor: For each individual, include the number of hours, and loaded rate to include all indirect costs. Identify key personnel by name if possible and labor category.

e) Travel: Travel costs must relate to the needs of the project. Proposed travel cost must be in accordance with the Federal Travel Regulation (FTR).

   1. Per Diem Rates can be obtained at: http://www.gsa.gov/perdiem
   2. The following information shall be documented –
      (i) Date (estimated), length and place (city, town, or other similar designation) of the trip;
      (ii) Purpose of the trip; and
      (iii) Number of personnel included in the estimate.

f) Cost Sharing: Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal. Please note that cost share contracts do not allow fees/profit.

g) Subcontracts: Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If the offeror intends such involvement, describe in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-half of the total contract price or cost, unless otherwise approved in writing by the Agreements Officer.

   Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e., cost proposal) or provide a statement of work with a corresponding detailed proposal for each planned subcontract.

h) Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required and hourly rate.

SBIR program requires the offerors must do at least 50% of the PHASE II SBIR work. To determine eligibility for award based on this requirement, USSOCOM will divide the overall price submitted/negotiated minus the total cost of subcontractors/consultants amount (with applied indirects), by the total price of the proposal. To qualify for award, the resulting offeror percentage of work shall be 50% or higher. If the percentage is lower, the proposal will not be evaluated.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will be considered by USSOCOM during proposal evaluations.

Supporting Documents (Volume 5)
In addition to the documentation outlined in the DoD SBIR Program BAA, the following USSOCOM documents **must** also be included in Volume 5: the (1) PowerPoint Presentation, (2) Feasibility Study (Appendix A), (3) section K and (4) resumes.

1. PowerPoint Presentation: Potential offerors shall submit a slide deck not to exceed 15 PowerPoint slides (inclusive of the cover sheet). There is no set format for this document. It is recommended

(but not required) that more detailed information is included in the technical volume and higher-level information is included in the slide deck suitable for a possible presentation. Refer to the "Direct to Phase II Evaluations" Section of this instruction for more details.

2. Feasibility Study: Offerors must provide documentation to satisfy the feasibility requirement explaining the previously done research and how it applies to the topic as specified in the Phase I topic write-up. The file with the documentation shall be named "Feasibility Appendix" and uploaded in this volume. Offerors are required to provide sufficient information to determine, to the extent possible, the scientific, technical, and commercial merit and feasibility of ideas submitted, and that the feasibility assessment was performed by the offeror and/or the Principal Investigator. If the offeror fails to demonstrate the scientific and technical merit, feasibility, and/or the source of the work, USSOCOM will not continue to evaluate the offeror's proposal. Refer to the topic's Phase I description associated with the Direct to Phase II topic to review the minimum requirements needed to demonstrate feasibility. There is no minimum or maximum page limitation for the Feasibility Appendix (Appendix A).

3. Section K - Titled "Representations, Certifications, and other statements of Offerors": The proposal must also include a completed Section K which does not count toward the page limit and should be uploaded with this volume. The identification of foreign national involvement in a USSOCOM SBIR topic is required to determine if a firm is ineligible for award on a USSOCOM topic that falls within the parameters of the United States Munitions List, Part 121 of the International Traffic in Arms Regulation (ITAR). A firm employing a foreign national(s) (as defined in paragraph 3.7 entitled "Foreign Nationals" of the DoD SBIR 22.4 Announcement) to work on a USSOCOM ITAR topic must possess an export license to receive a SBIR Phase II contract.

4. Resumes: Include resumes as required.

Fraud, Waste and Abuse Training (Volume 6)
Fraud, Waste and Abuse (FWA) training is required for Phase I and Direct to Phase II proposals. Please refer to the DoD SBIR Program BAA for full details.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

USSOCOM does not provide Discretionary Technical and Business Assistance for Direct to Phase II awards.

INQUIRIES
USSOCOM does not allow direct communication with the topic authors (differs from the DoD SBIR Program BAA instructions).

During the Pre-release and Open Periods of the DoD SBIR Program BAA, all, and only technical questions, that enhance the offeror's understanding of the topics requirements, must be submitted to the online Defense SBIR/STTR Innovation Portal (DSIP) Topic Q&A. All questions and answers submitted to DSIP Topic Q&A will be released to the general public.

Only questions pertaining to the proposal preparation instructions should be directed to: sbir@socom.mil. All inquiries must include the topic number in the subject line of the e-mail. **Consistent with DoD SBIR instructions, USSOCOM will not answer programmatic questions, such as who the technical point of contact is, the number of contracts to be awarded, the source of funding, transition strategy.**

VERSION 3

Physical site visits will not be permitted during the Pre-release and Open Periods of the DoD SBIR Program BAA.

EVALUATION AND SELECTION

All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR Program BAA.

The Government will evaluate only responsive proposals.

1. Proposals missing Technical Volume (Volume 2), Feasibility Appendix (Appendix A), Cost Volume (Volume 3), or slide deck (Volume 5) will not be evaluated or those that exceed the maximum price allowed as per Table 1 of this instructions. Those proposals will be considered non-responsive.

2. Feasibility determination. The Feasibility Appendix (Appendix A) to the Phase II proposal will be evaluated first to determine that the offerors demonstrated they have completed research and development to establish the feasibility of the proposed Phase II effort based on the criteria outlined in the topic description of Phase I**. USSOCOM will not continue evaluating the offeror's related Direct to Phase II proposal if it determines that the offeror failed to demonstrate that feasibility has been established or the offeror failed to demonstrate work submitted in the feasibility documentation was substantially performed by the offeror and/or the Principal Investigator.**

   Refer to the Phase I Topic description associated with the Direct to Phase II topic Statement of Objectives to review the minimum requirements that need to be demonstrated in the feasibility documentation.

3. The technical evaluation will utilize the Evaluation Criteria provided in the DoD SBIR Program BAA instructions. The Technical Volume and slide PowerPoint Presentation will be reviewed holistically. The technical evaluation is performed in two parts:

   Part I: The evaluation of the Technical Volume will utilize the Evaluation Criteria provided in the DoD SBIR Program BAA. Once the evaluations are complete, all offerors will be notified in a timely manner.

   Selected offerors **may** receive an invitation to present their slide deck (30-minute presentation time / 30-minute Government question and answer period) to the USSOCOM technical evaluation team, using virtual teleconference. This will be a technical presentation of the proposed solution ONLY. The key personnel listed in the proposal should represent the presentation and responding to the questions of the evaluation team. This presentation is NOT intended for business development personnel, it is purely technical. Selected offerors shall restrict their Pitch Day presentations to the 15-page PowerPoint presentations ONLY that were submitted with their respective proposals. There will be no changes or updates to the presentations from what was proposed. Selected firms may be asked to provide teleconference information for the presentation. This presentation will complete the evaluation of the proposal against the criteria listed in the DoD SBIR Program BAA. Notifications of selection/non-selection for Phase I award will be completed within a timely manner.

Part II: The Cost Volume award amount is set at a not to exceed (NTE) amount and a technical evaluation of the proposal cost will be completed to assess price fair and reasonableness. Proposals above the established NTE for the Phase I effort will not be considered for award. The team will assess the technical approach presented for the effort based on the number of labor hours by labor categories, the key personnel level of involvement, materials, subcontractors and consultants (scope of work, expertise, participation and proposed effort), and other direct cost as proposed.

4. The Cost Volume (Volume 3) evaluation:

   For these Direct to Phase II efforts, the award amount is set with not to exceed (NTE) amount. Technical evaluation of the proposal's cost will be completed to assess the probability of success to obtain a working prototype. Proposals above the set NTE for the effort **will not** be considered for award. The team will assess the probability of success of the technical approach, presented for the efforts. The technical team will assess number of labor hours, labor categories, key personnel expertise and level of involvement, materials, equipment, subcontractors and consultants (scope of work, expertise, participation and proposed effort), travel and other direct cost to successfully complete the effort as proposed.

The resulting award/s will be a fixed price prototyping agreement and a successful prototype may lead to follow on production. Follow on production awards may be FAR based, Fixed Price or Cost-Plus Fixed Fee contracts. A Defense Contracts Audit Agency approved accounting system will be required to issue a Cost-Plus Fixed Fee contract.

Additionally, input on technical aspects of the proposals may be solicited by USSOCOM from non-Government consultants and advisors who are bound by appropriate non-disclosure requirements. When appropriate, non-government advisors may have access to Offeror's proposals and may be utilized to objectively review a proposal in a particular functional area and provide comments and recommendations to the Government's decision makers. They may not establish final assessments of risk, rate or rank Offerors' proposals. All advisors shall comply with procurement Integrity Laws and shall sign Non-Disclosure and Rules of Conduct/ Conflict of Interest statements. The Government shall take into consideration requirements for avoiding conflicts of interest. Submission of a proposal in response to this request constitutes approval to release the proposal to Government support contractors.

Proposing firms will be notified of selection or non-selection status for a Direct to Phase II award within 90 calendar days of the closing date of the BAA by the USSOCOM Contracting Office. This notification will come by e-mail to the Corporate Official identified by the Offeror during proposal submission. The Government will also notify the Offerors if their proposal is considered non-responsive (disqualified).

A non-selected Offeror can make a written request to the Contracting Officer, within 30 calendar days of receipt of notification of non-selection, for informal feedback. The Contracting Officer will provide informal feedback after receipt of an Offeror's written request rather than a debriefing as specified in the DoD SBIR Program BAA instructions.

Refer to the DoD SBIR Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests after Award should be submitted to: sbir@socom.mil.

VERSION 3

AWARD AND CONTRACT INFORMATION

Table 1: Consolidated SBIR Topic Information

Topic	Technical Volume (Vol 2)	Additional Info. (Vol 5)	Period of Performance	Award Amount	Contract Type
SOCOM232-D004	Not to exceed 10 pages	15 page PowerPoint	Not to exceed 12 months	NTE $1,315,000	Firm-Fixed-Price

SBIR awards for the Direct to Phase II topics will be awarded as a fixed price (level of effort type), Other Transactions Agreements (OTA). Successful completion of the prototype under an OTA may result in a follow-on production OTA or contract. Successful completion of the prototype is defined as meeting one or more threshold requirements. Firms may download the template at https://www.socom.mil/SOF-ATL/Pages/sbir.aspx. The general terms and conditions are included in the draft OTA template provided in this solicitation. The terms and conditions of the Template OTA and the latest version of the OTA may be revised prior to execution. The document deliverables required for the effort are listed in the uploaded Statement of Objectives (SOO) for each topic. The OTA template uploaded is a basic draft and not tailored to the specific topic and is not the final document to be use in the award. Offerors must review these documents to develop their proposal.

The OTA template needs to be completed by only those offerors selected for award and will be submitted directly to the Agreements Officer identified in the notification. The specific OTA template for each topic will be sent to those selected to present the PowerPoint Presentation. Providing the completed OTA for those invited to present, is desirable but not required.

Those selected for award would be required to enter their company information, expected milestones (Attachment 1), and provide a non-proprietary Statement of Work (SOW) following the format of the Statement of Objectives (SOO) (Attachment 3).

ADDITIONAL INFORMATION

Direct to Phase II proposals shall NOT include:

1. “Basic Research” (or “Fundamental Research”) defined as a “Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind.”
2. Discretionary Technical and Business Assistance (TABA).

VERSION 3

USSOCOM SBIR 23.4 Direct to Phase II Topic Index

VERSION 3

SOCOM232-D004 TITLE: Digital Augmentation for Analog Systems

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Microelectronics

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 the Announcement. 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: The objective of this topic is to develop applied research toward an innovative capability to augment existing analog expeditionary optical systems with a see-through display capable of displaying text and imagery. Existing analog devices that could be augmented with this display capability include rifle scopes, red dot/holographic sights, and night vision goggles. This capability would hyper-enable SOF users by merging digital battlefield data with high-performance analog optical systems in a way that does not degrade baseline functionality/capability of the optic. In addition, such transparent display technology could be leveraged to create a tactical Heads-Up Display in the future.

IMPORTANT: For SOCOM instructions: please visit: https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/. Go to the bottom of the page and click the “DoD SBIR 23.2” tab. Once there, go to the SOCOM SBIR 23.2 Direct to Phase II document.

DESCRIPTION: The Digital Augmentation to Analog Systems (DAAS) feasibility study should examine currently available research and techniques for creating a see-through display capable of forming high-resolution digital imagery, while still maintaining a high level of visible light transmission from the “outside world” through the display substrate. The DAAS should be capable of mounting on the eyepiece of the SU-295 (5-25x), SU-296 (7-35x), and SU-303 (4-20x) riflescopes, and should display data overlaid with the image projected by the riflescope. The DAAS should be capable of receiving ballistic data (range to target, elevation/azimuth holds) from a LA-24/PEQ laser range finder, and displaying this information to the operator.

As a part of this feasibility study, the proposers shall address all viable overall system design options with respective specifications on display resolution, display focus distance, display brightness, substrate light transmission, and overall system size/weight.

PHASE I: Conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraphs entitled “Objective” and “Description.”
The objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study (“Technology Readiness Level 3”) to investigate what is in the art of the possible within

the given trade space that will satisfy a needed technology. The feasibility study should investigate all options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

PHASE II: Develop, install, and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on Digital Augmentation for Analog Systems.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of military applications where analog optical systems still provide a distinct performance advantage over fully digital systems (for example: aiming optics for small arms, night vision goggles, but could benefit from a digital overlay. Furthermore, this technology could also be applied towards a stand-alone Heads-Up Display in future developments.

There is a large market for see-through optical displays – from “Google Glass” type Heads Up Display products that apply to the broad commercial market, to the same type of riflescope overlay being proposed for this effort that applies to the civilian sport shooting market.

REFERENCES:

1. Transparent Screen Market is Anticipated to Progress, 2/19/23
2. https://www.globenewswire.com/news-release/2023/02/19/2611067/0/en/Transparent-Screen-Market-is-anticipated-to-progress-at-a-CAGR-of-45-0-from-2023-to-2030-Contrive-Datum-Insights.html; Pros and Cons of Four different Transparent Display Technologies, 9/9/2019
3. https://www.lumineq.com/blog/pros-and-cons-four-transparent-display-technologies-video-included

KEYWORDS: Transparent Display; Analog Optics, Rifle scope, Night Vision Goggles, HUD