

**DEPARTMENT OF THE NAVY (DON)**  
**24.1 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 topic only:**
  - N241-D01 through N241-D03
- Submitting small business concerns are encouraged to thoroughly review the DoD Program BAA and register for the DSIP Listserv to remain apprised of important programmatic changes.
  - The DoD Program BAA is located at: <https://www.defensesbirsttr.mil/SBIR-STTR/Opportunities/#announcements>. Select the tab for the appropriate BAA cycle.
  - Register for the DSIP Listserv at: <https://www.dodsbirsttr.mil/submissions/login>.
- 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](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](http://www.navysbir.com). Additional information on DON’s mission can be found on the DON website at [www.navy.mil](http://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.

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	DON SBIR/STTR Program Management Office <a href="mailto:usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil</a> or appropriate Program Manager listed 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 ( <a href="https://www.dodsbirsttr.mil/submissions">https://www.dodsbirsttr.mil/submissions</a> ) 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 <a href="mailto:dodsbirsupport@reisystems.com">dodsbirsupport@reisystems.com</a>
Navy-specific BAA instructions and forms	Always	DON SBIR/STTR Program Management Office <a href="mailto:usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil">usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil</a>

**TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS**

Topic Numbers	Point of Contact	SYSCOM	Email
N241-D01 to N241-D02	Ms. Kristi DePriest	Naval Air Systems Command (NAVAIR)	navair-sbir@us.navy.mil
N241-D03	Mr. Jon M. Aspinwall III (Acting)	Strategic Systems Programs (SSP)	ssp.sbir@ssp.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 24.1 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.dodsbirstr.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. Proposals that are encrypted, password protected, or otherwise locked in any portion of the submission will be REJECTED unless specifically directed within the text of the topic to which you are submitting. 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](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)	
N241-D01 and N241-D02	\$1,000,000	30 mos.	\$300,000	12 mos.	\$1,300,000
N241-D03	\$900,000	18 mos.	\$300,000	6 mos.	\$1,200,000

o 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.
- o 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](https://navysbir.com/links_forms.htm) to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
    - o Additional Cost Information to support the Cost Volume (Volume 3)
    - o SBIR/STTR Funding Agreement Certification
    - o Data Rights Assertion
    - o 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. The Due Diligence Program to Assess Security Risks will be implemented for all Phases.

**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 indirect costs, 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 Navy 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](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](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](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. A small business concern selected for an award **MUST** have an active SAM registration at the time of award or they will be considered ineligible.

**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](mailto: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.

**Navy Direct to Phase II SBIR 24.1 Topic Index**

- N241-D01 Direct to Phase II: Next-generation Autonomy for Unmanned Maritime Vehicles (UMVs)
- N241-D02 DIRECT TO PHASE II: Safeguarding Warfighter Medical Data: Secure Encrypted Transmission of Physiologic Monitoring (PhysMon) Data
- N241-D03 DIRECT TO PHASE II: Extended Lifetime Near-Infrared Lasers for Quantum Sensing

N241-D01 TITLE: DIRECT TO PHASE II: Ultrahigh-Dynamic Range Photonic-Assisted Direct Digitization Receiver

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Integrated Network Systems-of-Systems; Microelectronics; 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 photonic-enabled receiver that can directly digitize radio frequencies up to 4 GHz without desensitizing or compressing in the presence of strong interference.

**DESCRIPTION:** The benefits of direct digitization receivers are well known and include (1) software-defined signal processing over the entire operating frequency range, and (2) lower size, weight, and cost in comparison with superheterodyne receiver chains. Despite these advantages, two key limitations prohibit their use in certain demanding applications: (a) strong interference either desensitizes or compresses the entire spectrum, and (b) radio frequency (RF) sampling analog-to-digital converters (ADCs) consume large amounts of electrical power, which can be difficult to manage in certain harsh environments where antennas are deployed.

Microwave photonic signal processors and analog fiber-optic links are well suited to overcome these fundamental limitations.(3,4) In particular, wideband analog photonic phase modulation enables designers to encode analog signals in the optical domain without any small signal approximations, enabling the use of sensitive coherent receiver photonics to sample in-phase and quadrature components and decode phase information in the digital domain directly [Ref 1]. The benefits of analog signal transport over fiber are also well known, enabling coherent sampling multichannel receivers and power-hungry ADCs to be integrated in more amenable locations with access to power, cooling, and maintenance.

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 32 U.S.C. § 2004.20 *et seq.*, National Industrial Security Program Executive Agent and 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 during the advanced phases of this contract IAW the National Industrial Security Program Operating Manual (NISPOM), which can be found at Title 32, Part 2004.20 of the Code of Federal Regulations. **Reference:** National Industrial Security Program Executive Agent and Operating Manual (NISP), 32 U.S.C. § 2004.20 *et seq.* (1993). <https://www.ecfr.gov/current/title-32/subtitle-B/chapter-XX/part-2004>

**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:

Demonstrate the feasibility of a design of a photonic-assisted direct digitization receiver with a 3MHz–4 GHz target, 3MHz-2GHz threshold instantaneous bandwidth (IBW), an effective noise figure (NF) of < 8 dB target, < 13 dB threshold, and an input-referred full-scale power greater than 26 dBm target and 15dBm threshold from 3MHz-2GHz, and 15 dBm target -10 dBm threshold from 2 GHz–4 GHz. The direct digitization receiver should not desensitize or compress with spurious above ADC spurs over the entire input power range. With a noise figure (NF) less than 8 dB and an assumed SNR > 6 dB, the receiver should also be able to receive signals (1 MHz analysis bandwidth) down to < -100 dBm target, < -88 dBm threshold, even in the presence of in-band interference up to the aforementioned levels. The demonstration shall include prototype plans to be developed under Phase II.

**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 24.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

**PHASE II:** Create and test a functioning prototype exceeding the threshold performance objectives. Demonstrate a packaged design and real-time digital signal processing.

Work in Phase II may become classified. Please see note in Description paragraph.

**PHASE III DUAL USE APPLICATIONS:** Support the DoD in transitioning the proposed receiver to include working with a Program Office to develop a final packaging design that meets platform's Size, Weight, and Power (SWaP) and environmental requirements, and developing systems specifications for the associated analog photonic links. Development of this receiver has widespread commercial applications for commercial radar and 5G/6G receivers.

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**KEYWORDS:** Digitization; Electronic Warfare; EW; Receiver; Photonic; Radio Frequency; RF; Fiber

N241-D02 TITLE: DIRECT TO PHASE II: Safeguarding Warfighter Medical Data: Secure Encrypted Transmission of Physiologic Monitoring (PhysMon) Data

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

OBJECTIVE: Design and manufacture a more secure method of transmitting physiology endpoint data from wearable aircrew physiologic monitoring (PhysMon) devices.

DESCRIPTION: In 2010, the number of hazard reports from military aircrews related to physiological episodes (PEs) increased compared to previous years and have continued to rise sharply each year since 2012. An attributable cause to the increase in reported PE can be an increased awareness regarding the phenomenon; however, a single root cause has not been identified. PEs, as experienced by flight crews, have consisted of multiple symptoms, including cognitive impairment, numbness, tingling, lightheadedness, behavioral changes, and fatigue. These reports have been connected to several Class A mishaps, leading to a growing awareness across all aircraft activities on the recognition of inflight human symptomology. While reported PEs peaked in FY15–16, in recent years there has been a marked decline; however, they still occur, and between FY18 to FY23 there have been reports of 934 PEs, some resulting in significant medical complications. Most of the reported PEs have been in the F/A-18 community including legacy (F/A-18C) and super hornets (-E, -F, and -G); however, PEs are also reported in the T-46, T-6, and F-35 communities.

Since 2010, the U.S. Navy (USN) and U.S. Air Force (USAF) have been working diligently to determine the cause (or causes) of PEs. While several vulnerabilities have been identified and corrected, reports of PEs still persist (934 between FY18-23) and have shown to be difficult to diagnose with causal factors remaining elusive. Mitigating the risk of PE has proven to be complex and not rooted in one single cause. Additionally, it is critically important to note that this is not a U.S. Navy-exclusive problem. It is a joint issue affecting aviators and aircrew across the Department of Defense (DoD) component services, including the USAF, U.S. Army (USA), and our International partners. The USN stood up two root cause and corrective action (RCCA) teams for both the F/A-18 and the T-45 with the mission to investigate PE for both platforms. Among the 564 recommendations between the two teams, the RCCA recommended that the USN take actions to research aircraft components and physiological monitors for aircrew members; maintain, upgrade, and test aircraft components; as well as train aircrew members on gear fit and potential PE symptoms to reduce PEs.

In recent years, the DoD has invested a significant amount of funding and resources into the investigation of unexplained PEs within the flight environment. As part of this effort, devices to monitor the physiological state of aircrew have been proposed, prototyped, developed, and tested in a variety of environments, including in-flight. These devices range from forehead patches to measure near-infrared spectroscopy (NIRS, functional or cerebral), compression garments with integrated heart rate and respiratory sensors, eye trackers within helmets or simulated cockpits, pulse oximetry (SpO<sub>2</sub>), instrumented orinatal masks, and electroencephalography to measure neural activity during environmental exposures. Aircrew physiological monitoring during flight operations to identify signs and symptoms associated with PE end states could help better identify causal factors, improve treatments and outcomes, and return aircrew to operational duty sooner. Combined with the fact that PEs still occur, the requirement for aircrew PhysMon remains a top capability gap and a top safety issue across the DoD and component services.

The commercial medical instrument industry is well established in the manufacture of devices designed to monitor various physiological endpoints. The military leverages these commercially available devices as starting points to adapt, optimize, and ruggedize for operation in a dynamic aircraft environment and

hostile military environments. The common feature between those commercial medical devices and those specially augmented for the military is their means of connecting to IT devices to transmit their data. Bluetooth is a short-range wireless technology used for exchanging data between fixed and mobile devices over short distances. Medical monitoring devices universally employ this technology standard to transmit physiologic data. Additional benefits include reduced device bulk and no wires. Both are unwelcome snag hazards to worn flight gear and equipment/hardware inside the cabin/cockpit. Snag hazards are not only detrimental to crew resource management (CRM) for normal and combat operations, but can constitute a substantial impediment in the event aircrew are required to ditch from the aircraft. As a result, the PhysMon devices currently evaluated by the USN and USAF for use in operational flight environments also use Bluetooth.

Unfortunately, Bluetooth is not secure and is vulnerable to a variety of hacking and tracking methods. While its short range provides some measure of protection, the technology has continued to improve over time, and in the case of active U.S. military operations and Private Health Information (PHI), this is insufficient. Bluesnarfing (information theft), bluejacking (spam, phishing, malware), bluebugging (backdoor access to spy), bluesmacking (denial of service), and car whispering (eavesdropping on communications) make continued use of Bluetooth in deployed, wearable PhysMon devices an unacceptable risk.

The Navy requires a more secure method for transmitting data from wearable PhysMon devices and replace the universally used Bluetooth. While military versions will likely require additional security measures subject to the area of operations (AO) or area of responsibility (AOR), commercial development of a more secure method of transmission for wearable PhysMon devices would be positively received and relevant. Methods can include, but are not limited to, magnetic secure transmission. Important considerations are Size, Weight, and Power (SWaP) requirements, wireless capability, no interference with worn gear, and battery endurance.

While PhysMon devices are mature technologies and available commercially in various forms, operation in conjunction with aircrew flight/safety gear or within the unique confines of an aircraft cabin (hypobaric pressure, oxygen-enriched, temperature) was not a primary factor in their design. The USN and DoD have been developing a number of devices in response to PE that are optimized for military environments, but like their commercially available counterparts, these military-specific devices use Bluetooth for data transfer. The increased computerization of today's military and evolving cyber threats necessitate a more secure way for transmitting physiological data.

Advanced, innovative solutions for secure, encrypted transmission of data from wearable PhysMon devices are sought. Design can include, but is not limited to, Magnetic Secure Transmission (MST) technology, commercial encrypted wireless links (CEWL) or miniature encrypted wireless links (MEWL) and/or Ultra Wide Band (UWB) Radio Frequency Identification (RFID) and Wireless Intercom System (WICS).

The candidate technology will demonstrate the ability to securely transmit medical endpoint data from an existing wearable PhysMon device. The technology developed will eventually be required to be adapted to a flight environment on military aircraft with special emphasis on naval environments featuring moisture and salt. Highly desirable criteria include minimal size profile, low power requirements, long battery life, minimum weight and bulk, wireless, and no interference with flight/safety gear. In order to have a common reviewing process for all potential applicants, it is requested that all submitting performers, at a minimum, employ heartrate as the physiologic endpoint of the wearable monitoring device. 1. Threshold: The method of recording heartrate should be—at a minimum—similar to fitness trackers, Photoplethysmography (PPG). 2. Objective: Full wave 60Hz electrocardiogram (ECG).

Other important considerations include: 1. The device should provide secure transmission to both storage and real-time display of monitored physiologic endpoint data. 2. There are many existing commercial and military-optimized wearable PhysMon devices currently available. The ability to convert these existing devices for secure transmission of data is a desirable objective. 3. For existing wearable monitors, designs may not allow easy access into device housing for reasonable modification of machinery. An attachable dongle to these existing devices overriding the stock Bluetooth in favor of the secure method is a desirable objective. 4. This technology should be able to transmit data across a distance of at least 240 m (This is the range of Bluetooth 5.0. Bluetooth 4.0 is 60 m).

Note: NAVAIR will provide Phase I performers with the appropriate guidance required for human research protocols so 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: 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: the candidate technology will demonstrate the ability to securely transmit medical endpoint data from an existing wearable PhysMon device. The technology developed will eventually be required to be adapted to a flight environment on military aircraft with special emphasis on naval environments featuring moisture and salt. Highly desirable criteria include minimal size profile, low power requirements, long battery life, minimum weight and bulk, wireless, and not interfere with flight/safety gear. In order to have a common reviewing process for all potential applicants, it is requested that all submitting performers—at a minimum—employ heartrate as the physiologic endpoint of the wearable monitoring device.

1. Threshold: The method of recording heartrate should be—at a minimum—similar to fitness trackers, Photoplethysmography (PPG).

2. Objective: Full wave 60Hz electrocardiogram (ECG).

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 24.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

PHASE II: Develop a working prototype that securely transmits medical endpoint data from an existing wearable PhysMon device and is suitable for use in the flight environment and during operations. Ensure that the prototype meets the requirements listed below. Begin to validate the use of the prototype with human participants. Through this testing and evaluation process make iterative refinements to the

prototype. Required Phase II deliverables will include a working prototype, and a report about the overall project progress.

It is important to note that the goal of this SBIR topic is to develop a more secure method to transmit physiologic monitoring data from wearables rather than developing a new wearable device for monitoring. As such, this SBIR topic is open to applications proposing a new secure wearable monitor or modification of existing wearable monitor incorporating secure transmission methods of physiologic endpoint data. Additional endpoints such as respiration rate, pulse oximetry, and so forth are welcome. However, all performers must propose a device that measures heartrate.

Other important considerations include:

1. The device should provide secure transmission to both storage and real-time display of monitored physiologic endpoint data.
2. There are many existing commercial and military-optimized wearable PhysMon devices currently available. The ability to convert existing devices for secure transmission of data (desirable objective).
3. For existing wearable monitors, designs may not allow easy access into device housing for reasonable modification of machinery. An attachable dongle to these existing devices overriding the stock Bluetooth in favor of the secure method (desirable objective).
4. This technology should be able to transmit data across a distance of at least 240 m (the range of Bluetooth 5.0. Bluetooth 4.0 is 60 m).

Note: Please refer to the statement included in the Description above regarding human research protocol for Phase II.

**PHASE III DUAL USE APPLICATIONS:** Using the results and progress made during Phase II, complete any remaining work necessary to have the proposed solution meet the performance parameters described in this topic., Demonstrate its performance in a military-relevant environment and ensure production readiness.

Ensure that the final design solution is easily adaptable for occupations requiring physiologic monitoring during operations, including long-haul trucking. Availability to the private sector shall also be considered as the wearable medical device and fitness-tracker industries continue to grow and more of the public purchases for personal use.

The global wearable medical device and fitness-tracker market size is valued at \$26.8 billion in 2022. Companies including Apple, Samsung, Google, Fitbit, Oura, and Amazon continue to develop smaller, wearable devices that incorporate physiologic monitoring. Additionally, these devices also include GPS tracking, as well as integration and linking of cell phone/cloud account (AppleID, Google account, etc.) features such as ApplePay.

Commercial applications for such technology would be healthcare providers employing wearable PhysMon devices for their patients, long-haul trucking or commercial airline industry for monitoring alert-status of drivers and pilots, and, finally, private citizens using wearables for recreational use such as fitness trackers.

Secure wireless interlinking of commercial wearables, particularly those with the capability of contactless payment, would be highly received by the public.

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KEYWORDS: Physiologic monitoring; PhysMon; Encryption; Bluetooth; Aircrew; Electrocardiogram; Photoplethysmography



OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Nuclear;Quantum Science; 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: Enhance the reliability and operational lifetime of near-infrared (NIR) lasers to support the development of quantum sensors and atomic clocks.

DESCRIPTION: Atom-based instruments such as microwave and optical atomic clocks, atom interferometers, and atomic magnetometers, may be used to address a variety positioning, navigation and timing (PNT) challenges by providing ultra-precise timing, inertial sensing, and other auxiliary field measurements [Ref 1, 2]. Alkali atoms, particularly rubidium and cesium, are advantageous for low-size, -weight and power (SWaP) quantum sensors and clocks due to their high atomic vapor pressure, convenient microwave frequency ground state energy splittings, and strong optical transitions for state preparation and readout [Ref 1]. Unfortunately, the optical spectral lines of greatest interest for these atoms (particularly the D2 lines at 780 nm and 852.5 nm) fall at wavelengths near the low end of the NIR, so devices requiring these laser wavelengths do not benefit from the technical maturity and reliability of lasers developed for telecommunications (telecom) applications. The need for low-SWaP lasers operating at these alkali transition frequencies is currently well-served by distributed Bragg reflector (DBR) and distributed feedback (DFB) devices based on a Gallium arsenide (GaAs)/Aluminum gallium arsenide (AlGaAs) platform. Lasers of this type are currently limited to operational lifetimes in the range of 10,000 hours. Many applications for quantum sensors would benefit from extended operational lifetimes, enabling extended deployments on the order of 10 years or more without requiring costly servicing operations or replacement of components.

The Navy has a need for narrow linewidth, tunable NIR laser diodes in the range of 770-852.5 nm with extended operational lifetime. The increased aluminum content of the underlying epilayer material of diodes operating natively at these short wavelengths may lead to defects which reduce laser efficiency and reliability, ultimately shortening laser lifetime. Possible approaches to improving the performance of GaAs/AlGaAs devices include designs that reduce the aluminum content in active gain regions [Ref 3]. Alternative approaches to improving laser reliability include frequency-doubling a more mature, long-lifetime diode operating at a telecom wavelength [Ref 4], but this architecture requires development and miniaturization to remain SWaP-competitive with native frequency diodes.

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:

- Innovative approaches to the design of miniature packaged diode based lasers
- Operational lifetime exceeding 100,000 hours.
- Candidate laser technologies must be capable of single frequency operation (linewidth under 1 MHz),

- Must have the ability to be frequency-tuned to cover at least one atomic transition in the range of 770-852.5 nm (such as the Rb D2 line at 780.2 nm),
  - Must produce high output power (> 100 mW) in a single transverse spatial mode.
- SWaP efficiency of proposed approaches should be similar to that of existing commercial DFB/DBR devices.

PHASE II: Design, fabricate, package, and characterize a production run of high-reliability diode-based lasers meeting the linewidth, power, and tunability performance goals stated above. Lasers should be designed for nominally room temperature operation (20-30 °C). Any innovations relating to laser design and manufacture, from epitaxy through packaging may be considered in order to meet a threshold mean time to failure (MTTF) of 100,000 hours at nominal operating temperature (with a goal MTTF of 200,000 hours). An accelerated aging study shall be performed to assess the predicted lifetime of prototype devices, and a report summarizing results and methodology should be provided. A suitable laser package shall be identified for prototype laser delivery. By the end of Phase II, five (5) packaged lasers shall be delivered for testing. Each delivered device should pass initial burn-in tests, and should be characterized in terms of power and efficiency (light-current-voltage curve). Each delivered device must also be characterized in terms of its ability to be tuned over one alkali spectral line in the range 770 nm to 852.5 nm. The prototypes should be delivered by the end of Phase II.

PHASE III DUAL USE APPLICATIONS: The laser designs and fabrication processes developed in Phase II will enhance the reliability of quantum sensing and timekeeping systems. Support the Navy in transitioning the technology to Navy use. The prototypes will be evaluated through optical characterization and testing with relevant quantum sensing or timing systems. The end product technology could be leveraged to support both military/strategic applications as well as commercial applications. Military applications include optical atomic clocks and GPS denied navigation aids for long-duration missions such as quantum gravimeters and magnetometers. Additional commercial applications for these systems include resource exploration, geosensing, mapping, timing, time transfer for telecommunications, and deep space navigation.

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KEYWORDS: Laser reliability; Laser lifetime; Near-infrared laser; Quantum sensing; Atomic clock; Atom interferometry