DARPA

SBIR 16.2 DIRECT TO PHASE II PROPOSAL INSTRUCTIONS

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DARPA DIRECT TO PHASE II (DP2) PROPOSAL INSTRUCTIONS

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IMPORTANT NOTE REGARDING THESE INSTRUCTIONS

THESE INSTRUCTIONS ONLY APPLY TO PROPOSALS SUBMITTED IN RESPONSE TO DARPA 16.2 DIRECT TO PHASE II TOPICS. Please contact our office if you require Phase II Instructions or Direct to Phase II instructions for another solicitation.

Offerors responding to DARPA topics listed in Section 12.0 of this solicitation must follow all the instructions provided in the DoD Program Solicitation AND the supplementary DARPA instructions contained in this section. The section/paragraph numbering in these instructions is intended to correspond with the section/paragraph numbering of the 16.2 DoD Program Solicitation (http://www.acq.osd.mil/osbp/sbir/index.shtml).

Solicitation Closing Date: June 22, 2016, at 6:00 a.m. ET

1.0 INTRODUCTION

DARPA's mission is to prevent technological surprise for the United States and to create technological surprise for its adversaries. The DARPA SBIR Program is designed to provide small, high-tech businesses and academic institutions the opportunity to propose radical, innovative, high-risk approaches to address existing and emerging national security threats; thereby supporting DARPA's overall strategy to bridge the gap between fundamental discoveries and the provision of new military capabilities.

The responsibility for implementing DARPA's Small Business Innovation Research (SBIR) Program rests with the Small Business Programs Office.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Attention: DIRO/SBPO
675 North Randolph Street
Arlington, VA 22203-2114
sbir@darpa.mil
http://www.darpa.mil/work-with-us/for-small-businesses

Direct to Phase II (DP2)

15 U.S.C. §638(cc), as amended by NDAA FY2012, Sec. 5106, PILOT TO ALLOW PHASE FLEXIBILITY, allows the DoD to make an award to a small business concern under Phase II of the SBIR program with respect to a project, without regard to whether the small business concern was provided an award under Phase I of an SBIR program with respect to such project.

DARPA is conducting a "Direct to Phase II" pilot implementation of this authority for this 16.2 SBIR solicitation only and does not guarantee the pilot will be offered in future solicitations. Each eligible topic will indicate what documentation is required to determine if Phase I feasibility has been met and the technical requirements for a Direct to Phase II proposal.

ELIGIBILITY

Not all DARPA topics are eligible for a DP2 award. Offerors should read the topic requirements carefully. DP2 topics may accept Phase I and Direct to Phase II proposals or Direct to Phase II proposals only. DARPA reserves the right to not make any awards under the Direct to Phase II pilot. All other instructions remain in effect. Direct to Phase II proposals must follow the DARPA Direct to Phase II Solicitation Instructions.

REQUIREMENTS

Offerors interested in submitting a DP2 proposal in response to an eligible topic must 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. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI).

DARPA will not evaluate the offeror's related Phase II proposal if it determines that the offeror has failed to demonstrate that technical merit and feasibility has been established or the offeror has failed to demonstrate that work submitted in the feasibility documentation was substantially performed by the offeror and/or the principal investigator (PI).

DP2 proposals **MUST NOT** be related to or logically extend from any prior or ongoing federally funded SBIR or STTR work. Offerors interested in submitting a Phase II proposal to DARPA based upon prior or ongoing SBIR or STTR work should contact sbir@darpa.mil for instructions.

System Requirements

Use of the DARPA SBIR/STTR Information Portal (SSIP) is MANDATORY. The registered Corporate Official (CO) **MUST** authenticate into the SSIP (via the DARPA Extranet) to retrieve the source selection decision notice, to request debriefings, and to upload reports (awarded contracts only). DARPA SBPO will automatically create an extranet account for new users and send the SSIP URL, authentication credentials, and login instructions AFTER the 16.2 source selection period has closed. DARPA extranet accounts will ONLY be created for the individual named as the CO on the Proposal Cover Sheet. Offerors may not request accounts for additional users at this time.

DARPA contractors who are not eligible to receive a Common Access Card (CAC) are required to obtain a digital certificate from an approved External Certification Authority (ECA) vendor.

- If the SBC has or will register for multiple ECAs, one of the registered ECA e-mail addresses MUST match the CO e-mail address (listed on the Proposal Cover Sheet).
- Additional information will be sent to small business concerns (SBCs) selected for contract award

WARNING: The Corporate Official (CO) e-mail address (from the Proposal Cover Sheet) will be used to create a DARPA Extranet account. The same e-mail MUST also be used for ECA registration. Updates to Corporate Official e-mail after proposal submission may cause significant delays to communication retrieval and contract negotiation (if selected). Additional information in section 4.0.

3.0 DEFINITIONS

3.4 Export Control

The following will apply to all projects with military or dual-use applications that develop beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community):

(1) The Contractor shall comply with all U. S. export control laws and regulations, including 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, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other

approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

(2) The Contractor shall be responsible for obtaining export licenses, if required, before utilizing foreign persons in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the foreign person will have access to export-controlled technologies, including technical data or software.

(3) The Contractor shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

(4) The Contractor shall be responsible for ensuring that the provisions of this clause apply to its subcontractors.

Please visit http://www.pmddtc.state.gov/regulations_laws/itar.html for more detailed information regarding ITAR/EAR requirements.

3.5 Foreign National

Foreign Nationals (also known as Foreign Persons) means any person who is NOT:

a. a citizen or national of the United States; or
b. a lawful permanent resident; or
c. a protected individual as defined by 8 U.S.C. § 1324b

ALL offerors proposing to use foreign nationals MUST follow Section 5.4. c. (8) of the DoD Program Solicitation and disclose this information regardless of whether the topic is subject to ITAR restrictions. There are two ways to obtain U.S. citizenship: by birth or by naturalization. Additional information regarding U.S. citizenship is available at https://travel.state.gov/content/travel/en/legal-considerations/us-citizenship-laws-policies.html. Definitions for "lawful permanent resident" and "protected individual" are available under section 3.5 of the DoD instructions.

4.0 PROPOSAL FUNDAMENTALS

4.6 Classified Proposals

DARPA topics are unclassified; however, the subject matter may be considered to be a "critical technology" and therefore subject to Export Control Restrictions. See Export Control requirements in Section 3.3.

4.7/4.8 Human and/or Animal Use

Your topic may have been identified by the program manager as research involving Human and/or Animal Use. In accordance with DoD policy, human and/or animal subjects in research conducted or supported by DARPA shall be protected. Although these protocols were most likely not needed to carry out the Phase I, significant lead time is required to prepare the documentation and obtain approval in order to avoid delay of the DP2 award. Please visit http://go.usa.gov/cBtYW to review the Human Use PowerPoint presentation to understand what is required to comply with human protocols and http://go.usa.gov/cBtYd to review the Animal Use PowerPoint presentation to understand what is required to comply with animal protocols. Offerors proposing research involving human and/or animal use are encouraged to separate these tasks in the Technical Volume and Cost Volume in order to avoid potential delay of contract award.

a. **Human Use:** All research involving human subjects, to include use of human biological specimens and human data, selected for funding must comply with the federal regulations for human subject protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, *Protection of Human Subjects*

b. DoD Directive 3216.02, *Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research* (http://www.dtic.mil/whs/directives/corres/pdf/321602p.pdf).
    - Institutions awarded funding for research involving human subjects must provide documentation of a current Assurance of Compliance with Federal regulations for human subject protection, for example a Department of Health and Human Services, Office of Human Research Protection Federal Wide Assurance (http://www.hhs.gov/ohrp). 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.
    - For all proposed research that will involve human subjects in the first year or phase of the project, the institution must provide evidence of or a plan for review by an Institutional Review Board (IRB) upon final proposal submission to DARPA. The IRB conducting the review must be the IRB identified on the institution's Assurance. 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. Consult the designated IRB for guidance on writing the protocol. The informed consent document must comply with federal regulations (32 CFR 219.116). A valid Assurance along with evidence of appropriate training for all investigators should accompany the protocol for review by the IRB.
    - In addition to a local IRB approval, a headquarters-level human subjects regulatory review and approval is required for all research conducted or supported by the DoD. The Army, Navy or Air Force office responsible for managing the award can provide guidance and information about their component's headquarters-level review process. Note that confirmation of a current Assurance and appropriate human subjects protection training is required before headquarters-level approval can be issued.
    - The amount of time required to complete the IRB review/approval process may vary depending on the complexity of the research and/or the level of risk to study participants. Ample time should be allotted to complete the approval process. The IRB approval process can last between one to three months, followed by a DoD review that could last between three to six months. No DoD/DARPA funding can be used towards human subject research until ALL approvals are granted.

c. **Animal Use:** Any Recipient performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling and use in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Laboratory Animal Welfare Act of 1966, as amended, (7 U.S.C. 2131-2159); (ii) the guidelines described in National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals"; (iii) DoD Directive 3216.01, "Use of Laboratory Animals in DoD Program."
    - For submissions containing animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the PHS Policy on Humane Care and Use of Laboratory Animals, available at http://grants.nih.gov/grants/olaw/olaw.htm.
    - All Recipients must receive approval by a DoD certified veterinarian, in addition to an IACUC approval. No animal studies may be conducted using DoD/DARPA funding until the USAMRMC Animal Care and Use Review Office (ACURO) or other appropriate DoD veterinary office(s) grant approval. As a part of this secondary review process, the Recipient will be required to complete and submit an ACURO Animal Use Appendix, which may be found at http://mrmc.amedd.army.mil/index.cfm?pageid=research_protections.acuro_animalappendix

4.10 Debriefing

DARPA will provide a debriefing to the offeror in accordance with Federal Acquisition Regulation (FAR) 15.505. The source selection decision notice (reference 4.15 Notification of Proposal Status) contains instructions for requesting a proposal debriefing. Please also refer to section 4.10 of the DoD Program Solicitation.

Notification of Proposal Receipt

Within 5 business days after the solicitation closing, the individual named as the "Corporate Official" on the Proposal Cover Sheet will receive a separate e-mail from sbir@darpa.mil acknowledging receipt for each proposal received. Please make note of the topic number and proposal number for your records. The CO should add this address to their address book and whitelist to ensure all communications are received.

Notification of Proposal Status

The source selection decision notice will be available no later than 90 days after the solicitation close date for DP2 offerors. The individual named as the "Corporate Official" (CO) on the Proposal Cover Sheet will receive an email for each proposal submitted, from sbir@darpa.mil with instructions for retrieving their official notification from the SSIP. Please read each notification carefully and note the proposal number and topic number referenced. The CO must retrieve the letter from the SSIP 30 days from the date the e-mail is sent. After 30 days the CO must make a written request to sbir@darpa.mil for the source selection decision notice. The request must explain why the offeror was unable to retrieve the source selection decision notice from the SSIP within the original 30 day notification period. Selections are posted at https://sbir.defensebusiness.org/.

Refer to section 1.0 (System Requirements) for information regarding CO registration and DARPA extranet account creation.

4.11 Solicitation Protests

Interested parties may have the right to protest this solicitation by filing directly with the agency by serving the Contracting Officer (listed below) with the protest, or by filing with the Government Accountability Office (GAO). If the protest is filed with the GAO, a copy of the protest shall be received in the office designated below within one day of filing with the GAO. The protesting firm shall obtain written and dated acknowledgment of receipt of the protest.

Agency protests regarding the solicitation should be submitted to:
SBIR/STTR Solicitation Contracting Officer
WHS/Acquisition Directorate
1155 Defense Pentagon
Washington, DC 20301-1155
E-mail: jonathan.l.becker2.civ@mail.mil

Agency protests regarding the source selection decision should be submitted to:
DARPA
Contracts Management Office (CMO)
675 N. Randolph Street
Arlington, VA 22203
E-mail: scott.ulrey@darpa.mil and sbir@darpa.mil

4.14 DP2 Award Information

a. **Number of DP2 Awards**. DARPA reserves the right to select and fund only those proposals considered to be of superior quality and highly relevant to the DARPA mission. As a result, DARPA may fund multiple proposals in a topic area, or it may not fund any proposals in a topic area.
b. **Type of Funding Agreement**. DARPA DP2 awards are typically Cost-Plus-Fixed-Fee contracts.
    - Offerors that choose to collaborate with a University must highlight the research activities that are being performed by the University and verify that the work is FUNDAMENTAL RESEARCH.

- Offerors are strongly encouraged to implement a government acceptable cost accounting system to avoid delay in receiving a DP2 award. Phase II contractors MUST have an acceptable system to record and control costs, including procedures for job costing and time record keeping. Items such as overhead and G&A rates WILL require logical supporting documentation during the DCAA review process. Visit www.dcaa.mil and download the "Information for Contractors" guide for more information.
    - Offerors who do not have a cost accounting system that has been deemed adequate for determining accurate costs must provide the DCAA Pre-award Accounting System Adequacy Checklist in order to facilitate DCAA's completion of Standard Form (SF) 1408. The checklist may be found at: http://www.dcaa.mil/preaward_accounting_system_adequacy_checklist.html.
- Offerors that are unable to obtain a positive DCAA review of their accounting system may on a case-by-case basis, at the discretion of the Contracting Officer, be awarded a Firm Fixed Price Phase II contract or an Other Transaction (OT). For definition and information on Other Transactions for Prototype see the Fact Sheet and Other Transactions Guide for Prototype Projects at http://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program. While agreement type (fixed price or expenditure based) will be subject to negotiation, the use of fixed price milestones with a payment/funding schedule is preferred. Proprietary information must not be included as part of the milestones.

c. **Average Dollar Value**. The maximum value of a DARPA DP2 award is $1,510,000.

d. **Timing**. The DoD goal for DP2 award is within 180 calendar days from the proposal receipt deadline. Phase II contract award may be delayed if the offeror does not have an adequate accounting system or fails to include sufficient documentation to support its cost proposal.

4.15 Questions/Information

(1) Contact the **DARPA SBIR/STTR Help Desk** via email (sbir@darpa.mil) regarding general questions about these instructions, DP2 proposal preparation and other DARPA SBIR/STTR program-related areas.

(2) Contact the **DoD SBIR/STTR Help Desk** regarding questions about the DoD SBIR/STTR Proposal Submission System. Help Desk hours are 9:00 a.m. to 6:00 p.m. ET, Monday through Friday:

- Phone: 1-800-348-0787
- E-mail Submission: sbirhelp@bytecubed.com

Communication with DARPA Program Managers (PM)

Offerors participating in the DP2 process may only communicate with PMs during the pre-solicitation period, published at http://www.acq.osd.mil/osbp/sbir/index.shtml and on SITIS once the solicitation has opened. Information regarding SITIS is available directly from https://sbir.defensebusiness.org/.

4.22 Discretionary Technical Assistance (DTA)

DARPA has implemented the Transition and Commercialization Support Program (TCSP) to provide commercialization assistance to *SBIR and/or STTR awardees in Phase I and/or Phase II*. Offerors awarded funding for use of an outside vendor for discretionary technical assistance (DTA) are excluded from participating in TCSP.

DTA requests must be explained in detail with the cost estimate and provide purpose and objective (clear identification of need for assistance), provider's contact information (name of provider; point of contact; details on its unique skills/experience in providing this assistance), and cost of assistance (clearly identified dollars and hours proposed or other arrangement details). The cost cannot be subject to any profit or fee by the requesting firm. In addition, the DTA provider may not be the requesting firm itself, an affiliate or 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).

Offerors proposing DTA must complete the following:

1. Indicate in question 17, of the proposal coversheets, that you request DTA and input proposed cost of DTA (in space provided).
2. Provide a one-page description of the vendor you will use and the technical assistance you will receive. The description should be included as the LAST page of the Technical Volume. This description will not count against the 40-page limit of the technical volume and will NOT be evaluated.
3. Enter the total proposed DTA cost, which shall not exceed $5,000, under the "Discretionary Technical Assistance" line along with a detailed cost breakdown under "Explanatory material relating to the cost proposal" via the online cost proposal.

Approval of DTA is not guaranteed and is subject to review of the Contracting Officer. Please see section 4.22 of the DoD Program Solicitation for additional information.

7.0 DP2 PHASE II PROPOSAL

7.1 Introduction

DoD SBIR/STTR Proposal Submission System (https://sbir.defensebusiness.org/) is designed to reduce the time and cost required to prepare a formal proposal. Carefully review the guidance on allowable content.

A complete DP2 proposal consists of four volumes:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
PART ONE: Feasibility Documentation (75 page maximum)
PART TWO: Technical Proposal (40 page maximum)
Volume 3: Cost Volume
Volume 4: Company Commercialization Report

7.2 Proposal Provisions

Phase II Option

DARPA has implemented the use of a Phase II Option that may be exercised at the DARPA Program Manager's discretion to continue funding Phase II activities that will further mature the technology for insertion into a larger DARPA Program, DoD Acquisition Program, other Federal agency, or commercialization into the private sector. The statement of work for the Phase II Option MUST be included with the Phase II Technical Volume and should describe Phase II activities, over a 12 month period that may lead to the successful demonstration of a product or technology. The statement of work for the option counts toward the 40-page limit for the Phase II Technical Volume. If selected, the government may elect not to include the option in the negotiated contract.

7.4 Commercialization Strategy

DARPA is equally interested in dual use commercialization of SBIR/STTR project results to the U.S. military, the private sector market, or both, and expects explicit discussion of key activities to achieve this result in the commercialization strategy part of the proposal.

The Technical Volume of each Phase II proposal must include a commercialization strategy section. The Phase II commercialization strategy shall not exceed 5 pages, and will NOT count against the 40-page proposal limit. The commercialization strategy should include the following elements:

1. A summary of transition and commercialization activities conducted during Phase I, and the Technology Readiness Level (TRL) achieved. Discuss how the preliminary transition and commercialization path or paths may evolve during the Phase II project. Describe key proposed milestones anticipated during Phase II such as: prototype development, laboratory and systems testing, integration, testing in operational environment, and demonstrations.
2. Problem or Need Statement. Briefly describe the problem, need, or requirement, and its significance relevant to a Department of Defense application and/or a private sector application that the SBIR/STTR project results would address.
3. Description of Product(s) and/or System Application(s). Identify the commercial product(s) and/or DoD system(s), or system(s) under development, or potential new system(s) that this technology will be/or has the potential to be integrated. Identify the potential DoD end-users, Federal customers, and/or private sector customers who would likely use the technology.
4. Business Model(s)/Procurement Mechanism(s). Discuss business models, procurement mechanisms, and, as relevant, commercial investors or partners, and/or licensing/teaming agreements you plan to employ to sell into your targeted markets.
    a. What is the business model you plan to adopt to generate revenue from your innovation?
    b. Describe procurement mechanisms and potential private sector and federal partners you plan to employ to reach the targeted markets/customers.
    c. If you plan to pursue a licensing model, what is your plan to identify potential licensees?
5. Market/Customer Sets/Value Proposition. Describe the market and customer sets you propose to target, their size, and their key reasons they would consider procuring the technology.
    a. What is the current size of the broad market you plan to enter and the “niche” market opportunity you are addressing?
    b. What are the growth trends for the market and the key trends in the industry that you are planning to target?
    c. What features of your technology will allow you to provide a compelling value proposition?
    d. Have you validated the significance of these features and if not, how do you plan to validate?
6. Competition Assessment. Describe the competition in these markets/customer sets and your anticipated advantage (e.g., function, performance, price, quality, etc.)
7. Funding Requirements. List your targeted funding sources (e.g., federal, state and local, private (internal, loan, angel, venture capital, etc.), estimated funding amount, and your proposed plan and schedule to secure this funding. Provide anticipated funding requirements both during and after Phase II required to:
    - mature the technology
    - mature the manufacturing processes, if applicable
    - test and evaluate the technology
    - receive required certifications
    - secure patents, or other protections of intellectual property
    - manufacture the technology to bring the technology to market for use in operational environments
    - market/sell technology to targeted customers
8. Sales Projections. Provide a schedule that outlines your anticipated sales projections and indicate when you anticipate breaking even.
9. Expertise/Qualifications of Team/Company Readiness. Describe the expertise and qualifications of your management, marketing/business development and technical team that will support the transition of the technology from the prototype to the commercial market and into government operational environments. Has this team previously taken similar products/services to market? If the present team does not have this needed expertise, how do you intend to obtain it? What is the financial history and health of your company (e.g., availability of cash, profitability, revenue growth, etc.)?

10. Anticipated Commercialization Results. 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 company is required to report actual sales and investment data in its Company Commercialization Report (see Section 7.5.e) at least annually.
11. Advocacy Letters (OPTIONAL).* Feedback received from potential Commercial and/or DoD customers and other end-users regarding their interest in the technology to support their capability gaps. Advocacy letters that are faxed or e-mailed separately will NOT be accepted.
12. Letters of Intent/Commitment (OPTIONAL).* Relationships established, feedback received, support and commitment for the technology with one or more of the following: Commercial customer, DoD PM/PEO, a Defense Prime, or vendor/supplier to the Primes and/or other vendors/suppliers identified as having a potential role in the integration of the technology into fielded systems/products or those under development. . Letters of Intent/Commitment that are faxed or e-mailed separately will NOT be accepted.

*Advocacy Letters and Letters of Intent/Commitment are optional, and should ONLY be submitted to substantiate any transition or commercialization claims made in the commercialization strategy. Please DO NOT submit these letters just for the sake of including them in your proposal. These letters DO NOT count against any page limit.

In accordance with section 3-209 of DOD 5500.7-R, Joint Ethics Regulation, letters from government personnel will NOT be considered during the evaluation process.

DP2 PROPOSAL INSTRUCTIONS

Each DP2 proposal must be submitted through the DoD SBIR/STTR Submission Web site by the solicitation deadline. After authenticating, choose "Start New Direct to Phase II Proposal."

a. Proposal Cover Sheet (Volume One)

On the DoD SBIR/STTR Submission Web site, (https://sbir.defensebusiness.org/), prepare the Proposal Cover Sheet. The Cover Sheet must include a brief technical abstract, of no more than 200 words, that describes the proposed R&D project with a discussion of anticipated benefits and potential commercial applications. Do not include proprietary or classified information in the Proposal Cover Sheet. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released on the Internet. Once the Cover Sheet is saved, the system will assign a proposal number. You may edit the Cover Sheet as often as necessary until you submit your proposal.

b. Technical Volume (Volume Two)

- The Technical Volume upload must include two parts. Label the Feasibility Documentation "PART ONE: Feasibility Documentation." Part Two of the Technical Volume should be labeled "PART TWO: Technical Proposal.
- Number all pages of your Technical Volume consecutively. Use 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 company name, topic number, and proposal number assigned by the DoD SBIR/STTR Submission Web site when the Cover Sheet was created. The header may be included in the one-inch margin.
- The Technical Volume should cover the following items in the order given below.

VOLUME TWO - 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 75 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 offeror and/or the principal investigator (PI).
- If technology in the feasibility documentation is subject to IP, the offeror must have IP rights. Refer to section 11.5 of these DARPA instructions for additional information.
- Include a one page summary on Commercialization Potential addressing the following:
    i. Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
    ii. Describe the potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.
- DO NOT INCLUDE marketing material. Marketing material will NOT be evaluated and WILL be redacted.

VOLUME TWO - PART TWO: Technical Proposal

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

(2) **Phase II Technical Objectives**. Enumerate the specific objectives of the Phase II work, and describe the technical approach and methods to be used in meeting these objectives.

a) Phase II Statement of Work. The statement of work should provide an explicit, detailed description of the Phase II approach, indicate what is planned, how and where the work will be carried out, a schedule of major events and the final product to be delivered. 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 total proposal.

b) Human/Animal Use: Offerors 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.

c) Phase II OPTION Statement of Work. The statement of work should provide an explicit, detailed description of the activities planned during the Phase II Option, if exercised. Include how and where the work will be carried out, a schedule of major events and the final product to be delivered. The methods planned to achieve each objective or task should be discussed explicitly and in detail.

(3) **Related Work.** Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the offeror, consultants or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the offeror'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.

(4) **Relationship with Future Research or Research and Development.**

i. State the anticipated results of the proposed approach if the project is successful.

ii. Discuss the significance of the Phase II effort in providing a foundation for Phase III research and development or commercialization effort.

(5) **Commercialization Strategy.** Each DP2 proposal must contain a five-page commercialization strategy as part of the Technical Volume describing the offeror'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. See section 7.4 for required strategy elements.

(6) **Key Personnel.** Identify key personnel who will be involved in the Phase II effort including information on directly related education and experience. A concise resume of the principal investigator, including a list of relevant publications (if any), must be included. All resumes count toward the page limitation. Identify any foreign nationals you expect to be involved on this project, country of origin and level of involvement.

(7) **Facilities/Equipment**. Describe available instrumentation and physical facilities necessary to carry out the Phase II effort. Items of equipment to be purchased (as detailed in the cost proposal) shall be justified under this section. Also 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.

(8) **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 described in detail and identified in the Cost Volume. A minimum of one-half of the research and/or analytical work in Phase II, as measured by direct and indirect costs, must be carried out by the offeror, unless otherwise approved in writing by the Contracting Officer. No portion of an SBIR award may be subcontracted back to any Federal government agency, including Federally Funded Research and Development Centers (FFRDCs). SBA may issue a case-by-case waiver to this provision after review of the DoD component's written justification that includes the following information: (a) an explanation of why the SBIR research project requires the use of the Federal facility or personnel, including data that verifies the absence of non-federal facilities or personnel capable of supporting the research effort; (b) why the Agency will not and cannot fund the use of the Federal facility or personnel for the SBIR project with non-SBIR money; and (c) the concurrence of the small business concern's chief business official to use the Federal facility or personnel. Award is contingent on the sponsoring agency obtaining a waiver.

(9) **Prior, Current or Pending Support of Similar Proposals or Awards.** Warning -- 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 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 before award.

c. Cost Volume (Volume 3)

Offerors are REQUIRED to use the online Cost Volume (https://sbir.defensebusiness.org/) for the Phase II and Phase II Option costs. The Cost Volume (and supporting documentation) DOES NOT count toward the 40-page limit of the Technical Volume. Phase II awards and options are subject to the availability of funds.

The Phase II Cost Volume must not exceed the maximum dollar amount of $1,000,000 (24 months) or $1,010,000 if discretionary technical assistance services are proposed. Offerors proposing a Phase II Option must also submit a Phase II Option Cost Volume, not to exceed $500,000 (12 months).

Some items in the Cost Breakdown Guidance may not apply to the proposed project. If such 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 DARPA to understand how the offeror plans to use the requested funds if the 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. Special tooling and test equipment and material cost may be included. 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 Contracting Officer, be advantageous to the Government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/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 solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a DP2 proposal.
5. The costs for the base and option (if proposed) are clearly separate and identified in the cost volume.

If selected for award, the offeror should be prepared to submit further documentation to the DoD Contracting Officer to substantiate costs (e.g., a brief explanation of cost estimates for equipment, materials, and consultants or subcontractors). For more information about the Cost Volume and accounting standards, see the DCAA publication called "Information for Contractors" available at http://www.dcaa.mil/audit_process_overview.html.

d. Company Commercialization Report (CCR) (Volume 4)

All offerors are required to prepare a CCR through the DoD SBIR/STTR Submission Web Site (https://sbir.defensebusiness.org/). List in the CCR, the quantitative commercialization results of the offeror's prior Phase II projects, including the items such as sales revenue, additional investment, as well as other information relative to the offeror's commercialization track record. All prior Phase II projects must be reported, regardless of whether the project has any commercialization to date. The results are compared to the historical averages for the DoD SBIR or STTR Programs to calculate a Commercialization Achievement Index (CAI) value. Only offerors with four or more completed Phase II projects will receive a CAI score; otherwise the CAI is N/A. Offerors with a CAI at the 20th percentile or below may receive no more than half of the evaluation points available for commercial potential criteria. A score of N/A will not affect the offerors ability to be selected for an award.

Offerors may also include at the end of the Report additional, explanatory material (no more than five pages) relating to the offeror's record of commercializing its prior SBIR or STTR projects, such as: commercialization successes (in government and/or private sector markets) that are not fully captured in the quantitative results (e.g. commercialization resulting from the offeror's prior Phase I projects); any mitigating factors that could account for low commercialization; and recent changes in the offeror's organization or personnel designed to increase the offeror's commercialization success. The CCR and additional explanatory material (if any) will not be counted toward the page limit for DP2 proposals.

Modifications or Withdrawal of Proposals

Modification

Late modifications of an otherwise scientifically successful proposal, which makes its terms more favorable to the Government, may be considered and may be accepted.

Withdrawal

Proposals may be withdrawn by written notice at any time. Proposals may be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal.

DP2 PROPOSAL CHECKLIST

Complete proposals must contain the following elements. Incomplete proposals will be rejected.

____1. DP2 is NOT related to or logically extend from prior or ongoing SBIR/STTR work.

____2. Volume 1: Proposal Cover Sheets

____ a. Completed and checked for accuracy.

____ b. Costs for the base and option (if proposed) are clearly separate and identified on the Proposal Cover Sheet.

____3. Volume 2: Technical Volume

____ a. Numbered all pages of the proposal consecutively. The Cover Sheets are pages 1 and 2. The Technical Volume begins on page 3.

____ b. Font type is no smaller than 10-point on standard 8½" x 11" paper with one-inch margins. The header on each page of the Technical Volume contains the company name, topic number and proposal number assigned by the DoD SBIR/STTR Submission Web site when the Cover Sheet was created. The header may be included in the one-inch margin.

- **PART ONE: Feasibility Documentation (75 page maximum)**
  ____a. Does not exceed the page limits specified.
  ____b. Follows requirements specified in Section 7 (DP2 Proposal Format).
- **PART TWO: Technical Proposal (40 page maximum)**
  ____a. Does not exceed the page limits specified.
  ____b. The tasks for the base and option (if proposed) are clearly separate and identified in the Technical Proposal.
  ____c. If proposing DTA, one page description submitted in accordance with instructions in section 4.22.
  ____d. Follows requirements specified in Section 7 (DP2 Proposal Format).

____4. Volume 3: Cost Volume

____a. Used the online Cost Volume.

____b. Subcontractor, material and travel costs in detail. Used the "Explanatory Material Field" in the DoD Cost Volume worksheet for this information, if necessary.

____c. Costs for the base and option (if proposed) are clearly separate and identified in the Cost Volume.

____d. Base effort does not exceed $1,000,000 or $1,010,000 if DTA services are proposed.

____e. Option (if proposed) does not exceed $500,000.

____f. Included the cost of each ECA to be purchased. Reimbursement is limited to a maximum of three ECAs per company. See section 11.0 for additional information.

____g. If proposing DTA, cost submitted in accordance with instructions in section 4.22 and does not exceed $5,000 per year ($10,000 total).

____5. Volume 4: Company Commercialization Report

____ Completed and checked for accuracy. Follow requirements specified in section 5.4(e).

____6. Submission

____a. Upload four completed volumes: Volume 1: Proposal Cover Sheet; Volume 2: Technical Volume; Volume 3: Cost Volume; and Volume 4: Company Commercialization Report electronically through the DoD submission site by the solicitation closing date.
____b. Review your submission after upload to ensure that all pages have transferred correctly and do not contain unreadable characters. Contact the DoD Help Desk immediately with any problems (see section 4.15).
____c. Submit your proposal before the solicitation closing date. DARPA will NOT accept proposals that have NOT been submitted by the solicitation deadline.

8.0 PHASE II EVALUATION CRITERIA

DP2 proposals will be evaluated based on the criteria outlined below. Selections will be based on best value 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.

Evaluators will base their conclusions only on information contained in the proposal. Do not assume that evaluators are acquainted with the offeror or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained or referenced in the proposal and will count toward the page limit. Where technical evaluations are essentially equal in merit, cost to the Government will be considered in determining the successful offeror.

The offeror's attention is directed to the fact that non-Government advisors to the Government may review and provide support in proposal evaluations during source selection. Non-government advisors 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. These advisors will not establish final assessments of risk and will not rate or rank offeror's proposals. They are also expressly prohibited from competing for DARPA SBIR or STTR awards in the SBIR/STTR topics they review and/or provide comments on to the Government. All advisors are required to comply with procurement integrity laws and are required to sign Non-Disclosure Agreement and Rules of Conduct/Conflict of Interest statements. Non-Government technical consultants/experts will not have access to proposals that are labeled by their offerors as "Government Only."

Limitations on Funding

DARPA reserves the right to select and fund only those proposals considered to be of superior quality and highly relevant to the DARPA mission. As a result, DARPA may fund multiple proposals in a topic area, or it may not fund any proposals in a topic area. All awards are subject to the availability of funds.

11.0 CONTRACTUAL CONSIDERATIONS

External Certification Authority (ECA)

Offerors must include, in the Cost Volume, the cost of each ECA proposed to be purchased in order to be reimbursed for the cost of ECAs. Reimbursement is limited to a maximum of three ECAs per company. The cost cannot be subject to any profit or fee by the requesting firm.

Offerors should consider purchasing the ECA subscription to cover the Phase II period of performance, to include the option year. Offerors will only be reimbursed for ECA costs once per subscription. Offerors that previously obtained a DoD-approved ECA may not be reimbursed under any potential SBIR/STTR Phase II contract. Likewise, offerors that are reimbursed for ECAs obtained as a requirement under an SBIR/STTR Phase II contract, may not be reimbursed again for the same ECA purchase under any subsequent government contract. Additional information regarding ECA requirement may be found in section 1.0, System Requirements.

Security Requirements

If a proposed effort is classified or classified information is involved, the offeror must have, or obtain, a security clearance in accordance with the Industry Security Manual for Safeguarding Classified Information (DOD 5220.22M).

Payment Schedule

Payment will be made in accordance with General Provisions FAR 523.216-7, *Allowable Cost and Payments.*

11.4 Patents

Include documentation proving your ownership of or possession of appropriate licensing rights to all patented inventions (or inventions for which a patent application has been filed) that will be utilized under your proposal. If a patent application has been filed for an invention that your proposal utilizes, but the application has not yet been made publicly available and contains proprietary information, you may provide only the patent number, inventor name(s), assignee names (if any), filing date, filing date of any related provisional application, and a summary of the patent title, together with either: (1) a representation that you own the invention, or (2) proof of possession of appropriate licensing rights in the invention. Please see section 11.4 of the DoD Program Solicitation for additional information.

11.5 Intellectual Property Representations

Provide a good faith representation that you either own or possess appropriate licensing rights to all other intellectual property that will be utilized under your proposal. Additionally, proposers shall provide a short summary for each item asserted with less than unlimited rights that describes the nature of the restriction and the intended use of the intellectual property in the conduct of the proposed research. Please see section 11.5 of the DoD Program Solicitation for information regarding technical data rights.

11.1 (r) Publication Approval (Public Release)

National Security Decision Directive (NSDD) 189 established the national policy for controlling the flow of scientific, technical, and engineering information produced in federally funded fundamental research at colleges, universities, and laboratories. The directive defines fundamental research as follows: ''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."

It is DARPA's goal to eliminate pre-publication review and other restrictions on fundamental research except in those exceptional cases when it is in the best interest of national security. Please visit http://www.darpa.mil/about-us/public-affairs for additional information and applicable publication approval procedures.

11.7 Phase II Reports

All DARPA SBIR awardees are required to submit reports in accordance with the Contract Data Requirements List – CDRL and any applicable Contract Line Item Number (CLIN) of the Phase II contract. Reports must be provided to the individuals identified in Exhibit A of the contract.

Reports are uploaded to the DARPA SBIR/STTR Information Portal (SSIP). See section "Retrieval of DARPA SBPO Notifications" on page 4 of these instructions.

DARPA SBIR 16.2 Topic Index

*These instructions **ONLY** apply to **Direct to Phase II** Proposals. **For Phase I, refer to the DARPA 16.2 Phase I Topics and Proposal Instructions** available at (http://www.acq.osd.mil/osbp/sbir/index.shtml).*

Proposals Types Accepted

Topic	Topic Title	Phase I	DP2
SB162-001	Real-time Assessment of Antimicrobial Concentrations for Personalized Treatment of Infectious Diseases	YES	YES
SB162-002	Point-of-care Monitoring of the Host-Pathogen Interaction during Infection	YES	YES
SB162-003	Next Generation Research Tools for Understanding Human Social Systems	YES	YES
SB162-004	Secure Messaging Platform	YES	YES
SB162-005	Managing Emergent Behavior of Interacting Autonomous Systems	YES	YES
SB162-006	Innovative Technologies for High Power Amplification at THz frequencies	YES	YES
SB162-007	Integrated Interface Layer for Micromagnetics and RF Computational Engines	YES	YES
SB162-008	Distributed Coherent Communications	YES	YES
SB162-009	Software/Analytics Exploiting Commercial Satellite Imagery	YES	YES
SB162-010	Near-Photon-Counting, High Dynamic Range, Passive Vision Detector Arrays	YES	YES
SB162-011	Distributed, Large Scale Spectrum Measurement and Analysis	YES	YES
SB162-012	Complementary Piezo Energy Harvesting for Small Satellites in Eclipse	YES	NO
SB162-013	Telemetry Buoy - TM Collection System	YES	NO
SB162-014	Light-weight and Low Cost Composite Cryotank	YES	YES
SB162-015	Autonomous Detection of Near-Surface Marine Mammals	YES	YES

DARPA SBIR 16.2 Topic Descriptions

SB162-001 TITLE: Real-time Assessment of Antimicrobial Concentrations for Personalized Treatment of Infectious Diseases

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Biomedical, Materials/Processes

OBJECTIVE: Develop a real-time device capable of measuring small-molecule antibiotic drug concentrations from a small quantity of blood in less than 30 minutes. The application of this technology would be improved and personalized antibiotic administration, which would diminish the likelihood of the development of antimicrobial resistance.

DESCRIPTION: There is an urgent DoD need to optimize antimicrobial dosing to address the prevalence of drug-resistant pathogens and the increase of minimum inhibitory concentrations (MICs) of antimicrobials. Recent evidence suggests that current antimicrobial dosing may be inadequate for some critically ill patients. Specifically, variable metabolism of antibiotics due to the patient's current state of illness, as well as heterogeneity among patients in the metabolism and antimicrobials, lead to substantial fluctuations in levels. The ability to measure drug concentrations in near real-time would greatly facilitate treatment and reduce the risk of administering suboptimal doses of antimicrobials. Unfortunately, the reliance on laboratory-scale equipment such as high-performance liquid chromatography (HPLC) to quantify drug concentrations precludes measurement at the point of care.

PHASE I: Develop a benchtop breadboard device to demonstrate feasibility of approach. Deliverables will include a detailed device design plan, regulatory plan, Phase II commercialization strategy, and Phase I final report.

PHASE II: Compare the performance of the breadboard device developed in Phase I with gold standard testing (e.g., HPLC) to determine the performance characteristics of the system in an in vitro and in vivo small animal model. Modify the approach to ensure that the device meets the minimum specifications outlined below. In addition, develop and implement a design-for-manufacturability strategy. Deliverables will include ten standalone prototype devices suitable for user evaluation, and Phase II final report.

The device prototype will be required to meet the following specifications:
• Antimicrobials of Interest: Amphotericin; Voriconazole; Colistin; Gentamicin; Meropenem (1 specimen per test)
• Specimen Matrix: Blood (< 50 μL drop)
• Limit of Detection: Dependent on drug (specify & justify in proposal)
• Dynamic Range: Dependent on drug (specify & justify in proposal)
• Error and Uncertainty: Specify & justify in proposal (compared to gold standard measurement and across multiple measurements)
• Test Turnaround Time (TAT): < 30 minutes
• Ease of Use: Low complexity; < 5 steps by user with one timed step requiring < 5 minutes of user intervention
• User Interface: Results displayed on screen with capability to save and recall previous results
• Power: AC and battery (> 8 hour lifetime; > 15 tests between charges)
• Training: Minimal; instructions and graphical aides sufficient for user operation
• Storage: Reagents do not require cold-chain and shelf stable > 12 months
• Form Factor: Handheld device for sample preparation and measurement
• Communications Interface: USB with computer for data upload/download

The ultimate device may be comprised of a disposable component containing the reagents and a non-disposable component (e.g., pumps, power supply, electronics etc.). The device form factor should be suitable for use at the point of care by a nurse or physician, similar to commercially available glucose meters. Sample preparation by the user should be minimal and all reagents required should be self-contained within a disposable component and not

require refrigeration. The device should accept specimens from the patient using standard clinical methods (e.g., finger prick or venous whole blood).

PHASE III DUAL USE APPLICATIONS: A clear plan towards FDA approval for the device should be implemented and additional testing to meet FDA requirements will be completed. Additional funding may be provided by DoD sources, but the awardee must also look toward other government or civilian funding sources to continue the process of translation and commercialization. If successful, this device would have clinical utility in both civilian and military settings. Acquisition customers include the US Army Medical Research and Materiel Command (MRMC) and Defense Health Agency (DHA).

REFERENCES:
1. Akers, KS. Colistin Pharmacokinetics in Burn Patients during Continuous Venovenous Hemofiltration. Antimicrobial Agents and Chemotherapy 59, 46-52 (2015).

2. Ferguson, BS. Real-Time, Aptamer-Based Tracking of Circulating Therapeutic Agents in Living Animals. Science Translational Medicine 5, 213ra165 (2013).

3. Wong, G. How do we use therapeutic drug monitoring to improve outcomes from severe infections in critically ill patients? BMC Infectious Diseases 14, 288-299 (2014).

KEYWORDS: Therapeutic drug monitoring; point-of-care test; drug concentration; biosensor; personalized medicine

SB162-002 TITLE: Point-of-care Monitoring of the Host-Pathogen Interaction during Infection

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: Develop point-of-care technologies to monitor and characterize host-pathogen interactions during acute severe infection.

DESCRIPTION: There is a critical DoD need to develop a system that could be used at the point of care for monitoring in near real time host-pathogen interactions that would enable personalized therapeutic interventions during acute severe infection. Proposed approaches must go beyond traditional techniques for diagnosis based on microbiological testing, clinical signs, symptoms, and physiology to enable more targeted and appropriate interventions. Parameters of interest include, but are not limited to nucleic acids, cytokines, coagulation factors, hemopexin, and pathogen-associated molecular pattern (PAMP) molecules. The proposed technique must be capable of frequently measuring analytes and be in a format suitable for point-of-care use. During the course of severe clinical infection, the fluctuating status of patients requires frequent monitoring that ultimately informs treatment. Patient outcomes are determined by the invading pathogen(s), subsequent host response, and therapeutic intervention. For example, sepsis arises from an exuberant host response to infection that results in collateral organ and tissue damage. This syndrome represents a major health challenge and is one of the most common causes for admission into intensive care units (ICU). Blood culture is considered the gold standard for diagnosis and identification of pathogens in the bloodstream, but is insensitive and suffers from a long turnaround time.

PHASE I: Demonstrate feasibility of the approach in a breadboard configuration. A detailed design and manufacturing plan, animal testing plan, regulatory plan, and commercialization strategy shall be delivered with the final report.

PHASE II: Develop prototypes of the system. The performance characteristics of the system shall be evaluated using clinically relevant samples. Manufacturing of the system should be done under GMP conditions. A regulatory package should be drafted with the requisite supporting information. The device prototype will be required to meet the following specifications:

• Specimen Matrix: Blood (< 50 μL drop)
• Limit of Detection: Dependent on analyte (specify & justify in proposal)
• Dynamic Range: Dependent on analyte (specify & justify in proposal)
• Error and Uncertainty: Specify & justify in proposal (compared to gold standard measurement and across multiple measurements)
• Test Turnaround Time (TAT): < 30 minutes
• Ease of Use: Low complexity; < 5 steps by user with one timed step requiring < 5 minutes of user intervention
• User Interface: Results displayed on screen with capability to save and recall previous results
• Power: AC and battery (> 8 hour lifetime; > 15 tests between charges)
• Training: Minimal; instructions and graphical aides sufficient for user operation
• Storage: Reagents do not require cold-chain and shelf stable > 12 months
• Form Factor: Handheld device for sample preparation and measurement
• Communications Interface: USB with computer for data upload/download

PHASE III DUAL USE APPLICATIONS: A clear plan towards FDA approval for the device should be implemented and additional testing to meet FDA requirements will be completed. Additional funding may be provided by DoD sources, but the awardee must also look toward other government or civilian funding sources to continue the process of translation and commercialization. If successful, this device would have clinical utility in both civilian and military settings. Acquisition customers include the US Army Medical Research and Materiel Command (MRMC) and Defense Health Agency (DHA).

REFERENCES:
1. Jain, A. A shear gradient-activated microfluidic device for automated monitoring of whole blood haemostasis and platelet function. Nature Communications 7 (2016).

2. Kellum, JA. Understanding the inflammatory cytokine response in pneumonia and sepsis. Arch Internal Medicine 15, 1655 – 1663 (2007).

3. McHugh, L. A molecular host response assay to discriminate between sepsis and infection-negative systemic inflammation in critically ill patients: Discovery and validation in independent cohorts. PLoS Medicine 12, 1 – 35 (2015).

4. Oved, K. A novel host-proteome signature for distinguishing between acute bacterial and viral infections. PLoS One 10, 1 – 18 (2015).

5. Service, RF. Will biomarkers take off at last? Science 321, 1760 (2008).

6. Taslik, EL. Host gene expression classifiers diagnose acute respiratory illness etiology. Science Translational Medicine 8, 322ra11 (2016).

KEYWORDS: Host-pathogen interaction; point-of-care; prognostic; diagnostic; pathogen-associated molecular pattern (PAMP) molecules; nucleic acid detection; hemopexin; cytokines

SB162-003 TITLE: Next Generation Research Tools for Understanding Human Social Systems

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Human Systems, Information Systems

OBJECTIVE: Develop tools to support innovation in advancing best practice research methods and capabilities for the social, behavioral, and economic (SBE) sciences, which include, but not limited to: analysis software, workflow systems, statistical packages, experimental platforms, and others.

DESCRIPTION: There is a critical DoD need for accurate and robust, reliable social, behavioral, and economic (SBE) models, which are increasingly important for planning and conducting effective military operations, including humanitarian aid, disaster relief, and stability support missions. The SBE sciences provide essential theories and frameworks that shape understanding of a wide range of human social behavior and systems of relevance for national security. The validity and reliability of SBE theories and concepts are fundamental to strong tactical, operational, strategic, and policy-level decision-making across the Department of Defense.

In light of several widely recognized "crises" in reproducibility in a number of disciplines, there is increased appreciation for the importance – and challenge – of experimentally validating results and claims of theories or model predictions. The academic community has responded by identifying a wide range of biases in the published literature, as well as their sources in experimental, statistical, and institutional structures and practices. Fortunately, a number of best practices and innovative methods have been developed to mitigate some of these challenges – but there remain opportunities for further development and dissemination of tools that, if matured and adopted, could have significant positive impact on a wide range of research questions and communities in SBE.

Accordingly, this topic is soliciting proposals for innovative tools that could demonstrate this positive impact. Examples might include proposals that provide credible approaches to improve the speed, efficiency, cost and/or adoption of one or more of the following tools: methods for pre-registration of experimental protocols; tools for transparent, modular, dynamic, and portable informed consent; Bayesian Net tools for tracking contingent evidentiary support structures within complex data or experimental designs; statistical tools to help identify and mitigate different biases in published or unpublished research; meta-analytic tools for exploring the robustness and generalizability of empirical findings; extensible packages for the analysis of text or geocoded data; assimilation methods for tuning computational models using real-time observations; licensing models for ethical data-sharing that protects Personally Identifiable Information (PII); platforms for joint collaboration and design of experimental protocols to increase scientific value prior to data collection; methods to obtain institutional pre-approval of widely-used experimental platforms like online surveys or games; and platforms that ethically and cost-effectively recruit a large number of experimental subjects across a wide range of cultural and demographic variables.

This topic is generally not seeking to fund approaches that are tightly tied to narrow experimental protocols or sensor systems, rely on restricted or excessively costly software and/or data sets, or visualization tools not explicitly tied to reproducible analytic techniques. Hardware and sensor approaches should leverage widely-available existing platforms and any proposed development efforts must focus on range of application, ease of use, and low barriers of entry for adoption of the tool or tools by academic, government, and commercial SBE researchers.

PHASE I: Identify the target research practice, protocol, or method that will be improved by the tool, and justify your approach via detailed specification of the degree of improvement over current practice, or a description of the new capabilities afforded. Demonstrate the key technical principles behind the proposed solution, and identify mitigations for any barriers to scale. The demonstrations should show wide applicability and relevance and potential benefit for common methodological approaches or challenges in the SBE sciences. Phase I deliverables are a notional prototype that achieves the core functionality of the complete product, as well as an extensive commercialization/propagation plan for achieving widespread use, and a final report.

PHASE II: Demonstrate scale and usability of the proposed approach. The demonstration should validate the predicted improvements and/or new capabilities versus current state of practice, as well as the engineering and design work required to easily scale. This includes integrations into existing systems and the development of institutional partnerships. The Phase 2 deliverables include the prototype system and a final report that includes the

demonstration system design and test results.

PHASE III DUAL USE APPLICATIONS: Commercial applications may include product development, collaboration and workforce productivity tools, privacy enhancement, business intelligence, and data management. Military applications may include rapid ethnographic assessment, mission planning and logistics, crisis response and disaster relief.

REFERENCES:
1. Nature special issue on "Challenges in irreproducible research" - online at http://www.nature.com/news/reproducibility-1.17552

2. Ruths, D., and Pfeffer, J. "Social media for large studies of behavior." Science, Vol. 346, Issue 6213 (2014): 1063-1064

3. Pashler, Harold, and Eric–Jan Wagenmakers. "Editors' Introduction to the Special Section on Replicability in Psychological Science: A Crisis of Confidence?." Perspectives on Psychological Science 7.6 (2012): 528-530.

4. Ioannidis, John PA, et al. "Publication and other reporting biases in cognitive sciences: detection, prevalence, and prevention." Trends in cognitive sciences 18.5 (2014): 235-241.

5. Haeussler, Carolin, et al. "Specific and general information sharing among competing academic researchers." Research Policy 43.3 (2014): 465-475.

6. Schrodt, Philip A. "Seven deadly sins of contemporary quantitative political analysis." Journal of Peace Research 51.2 (2014): 287-300.

7. King, Gary. "Restructuring the Social Sciences: Reflections from Harvard's Institute for Quantitative Social Science." PS: Political Science & Politics 47.01 (2014): 165-172.

KEYWORDS: social sciences, statistics, analysis, research practice, psychology, economics, behavioral science, data security

SB162-004 TITLE: Secure Messaging Platform

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Create a secure messaging and transaction platform that separates the message creation, from the transfer (transport) and reception of the message using a decentralized messaging backbone to allow anyone anywhere the ability to send a secure message or conduct other transactions across multiple channels traceable in a decentralized ledger.

DESCRIPTION: There is a critical DoD need to develop a secure messaging and transaction platform accessible via web browser or standalone native application. The platform separates the message creation, from the transfer of the message within a secure courier to the reception and decryption of the message.

Legacy messaging and backoffice infrastructures, traditionally based on centralized, unencrypted hub-and spoke database architecture, are expensive, inefficient, brittle and subject to cyber attack. The overhead costs of maintaining such architectures is rising rapidly. Many organizations unknowingly keep duplicate information and fail to ensure synchronization thus amplifying the potential for data theft and data corruption/rot. Incorporating a truly transparent mechanism for conducting journaled transactions enables the DoD to leverage its distributed

footprint for a reduction in latency of these transactions, their security and their integrity and assurance.

The messaging platform will transfer messages via a secure decentralized protocol that will be secured across multiple channels, including but not limited to: 1) Transport protocol, 2) Encryption of messages via various application protocols, 3) Customized blockchain implementation of message deconstruction and reconstruction, and decentralized ledger implementation. With this messaging platform the business logic of the DoD ecosystem would be mapped onto a network of known entities using distributed ledgers. By doing this significant portions of the DoD backoffice infrastructure can be decentralized, 'smart documents and contracts' can be instantly and securely sent and received thereby reducing exposure to hackers and reducing needless delays in DoD backoffice correspondence. As an example, Military Interdepartmental Purchase Requests (MIPR) could be implemented using the secure ledger. Regulators with access to the ledger could read the correspondence and thus easily verify that a MIPR transaction didn't violate Federal Acquisition Regulations (FAR).

The messaging platform would act as the transport for a cyptographically sound record of all transactions whether they be MIPRs, contracts, troop movements or intelligence. Troops on the ground in denied communications environments would have a way to securely communicate back to HQ and DoD back office executives could rest assured that their logistics system is efficient, timely and safe from hackers. The benefits are broad and could even be applied to domains such as space. With crowded skies it's important to maintain situational awareness of all satellites and those concerned with space situational awareness/telemetry or air traffic control could instantly share data between nations using a separate but equivalent ledger implementation thus removing questions as to the authenticity and integrity of the data.

PHASE I: Create a specific decentralized messaging platform built on the framework of an existing blockchain framework. There are several layers of complexity that will be explored in this phase from the messaging platform, to transport protocol, to end user application. Phase 1 goals include: creating a model for the decentralized messaging platform, experimenting with encryption schemes, evaluating hardware to be used in combination with the messaging platform to provide additional security, and defining the product feature set from the application and platform perspectives and finally, developing a blueprint of the platform architecture mapped to DoD constructs.

PHASE II: Develop, test and evaluate a working prototype with the following features:
• Decentralized back end blockchain implementation
• Data aggregation, reconstruction
• Data transport protocol implementation
• End user application implementation (alpha)
• Conduct simulated MIPR transactions using the decentralized ledger
• Allow transparent regulatory review of DoD legal findings and contracts
• Significant reduction in time for regulatory overview of various transactions
• Tracking of aircraft or satellites with simulated telemetry or air traffic control data
• System Admin and Monitoring tools and engine
• Integration of hardware or edge of network hardware components

PHASE III DUAL USE APPLICATIONS: The DoD requires a secure messaging system that can provide repudiation or deniability, perfect forward and backward secrecy, time to live/self delete for messages, one time eyes only messages, a decentralized infrastructure to be resilient to cyber-attacks, and ease of use for individuals in less than ideal situations. Based on the outcomes and feedback from Phase 2, Phase 3 will focus on commercialization and full-scale implementation of the platform. This entails converting the alpha of the end user application into a beta application and increasing user testing and platform monitoring and industrializing the back-end platform in terms of decentralized ledger architecture and blockchain implementation.

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KEYWORDS: email, end-to-end encryption, privacy, security, secure messaging, repudiation, perfect forward secrecy

SB162-005 TITLE: Managing Emergent Behavior of Interacting Autonomous Systems

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Battlespace, Information Systems

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

OBJECTIVE: Develop meta-heuristic algorithms for the management of interacting autonomous agents by leveraging insights from highly resilient biological systems.

DESCRIPTION: Modern warfare requires reacting to ever-greater numbers of autonomous systems, not only in the form of vehicles, but also as agents working in cyber defense [1,2] and in social media [3,4]. As a result, there is a critical DoD need for the development of control strategies for groups of autonomous agents ("swarms"), in particular, strategies that would allow for resilient performance when interacting with other (friendly, neutral, or hostile) swarms employing their own, potentially unknown, strategies. Such interactions can lead directly to unexpected and potentially adverse emergent behaviors. The U.S. stock market “flash crash” of 2010 [5,6] is one example of adverse emergent behavior resulting from, in part, the interaction of autonomous agents with proprietary and largely unobservable internal workings.

In future joint operations, coordination of swarms will become a strict requirement to prevent unwanted emergent behavior. Similarly, managing interactions with neutral and adversarial autonomous agents in “gray zone” [7] and major combat operations will be essential. In all cases, the autonomous agents may be required to function and coordinate/manage interactions under a large variety of conditions without a robust model of their interacting partner or adversary systems. This lack of models makes the common modeling- and simulation-based approach to the design of autonomous system control strategies [8] less effective. An alternative approach is to focus on developing novel control strategies based on advanced meta-heuristic algorithms [9] that provide the necessary resilience to interactions with other systems.

Research into the social behavior of species such as wasps, ants, and bees [10-12] (as well as the collective behavior of cells [13], such as bacteria, yeast, and amoebae) has the potential to help identify useful such meta-heuristic control strategies, as they (a) exhibit strong parallels to autonomous agents, with processing and action at both individual and group levels [10], (b) necessarily and routinely engage in interactions within colonies, across colonies, across species, and across varied environments, and (c) have evolved highly resilient policies governing a number of forms of synchronized and coordinated behavior. The study of biological systems and their control strategies—which have evolved over millions of years to provide resilience in the face of a wide array of challenges—has already contributed significantly to computer science [14–17] and autonomous systems research [18–20].

Furthermore, research on non-vertebrate species can typically be done rapidly and at low cost, with established rigorous experimental practices for investigating specific classes of interactions. These biological systems therefore represent a vast natural library of meta-heuristic algorithms that could be used in the design of control strategies, and, in addition, can serve an experimental platform for investigating specific classes of interactions.

The focus of this work will be on leveraging research in biological systems to identify strategies and develop algorithms for coping with emergent behavior in shared environments with both competitive and non-competitive autonomous systems. Domains of interest include, but are not limited to: cyber defense, social media, data-mining,

unmanned vehicles, and complex system design (see, e.g., [21]).

PHASE I: Define one or more compelling problem domains related to national security where swarms of autonomous agents interact in shared environments. Identify one or more non-vertebrate species (not subject to animal use guidelines) that can provide insights into the control of autonomous agents and provide detailed rationale for their selection. Develop experimental design for biological system study and conduct a pilot study. Prototype a software framework for testing, in simulation, algorithms embodying new meta-heuristic control strategies. Develop and demonstrate simple algorithms based on the result of the pilot study and/or prior research data, explicitly show the biological system basis for the strategies, and compare performance to existing algorithms. The Phase I final report will include an experimental plan to be executed under Phase II.

PHASE II: Execute the experimental plan developed under Phase I to study the most informative forms of interaction in the chosen species. Develop and demonstrate algorithms based on results of the experiments, explicitly show the biological basis for the strategies, and compare performance to existing strategies. Implement the software framework for testing, in simulation, algorithms embodying higher-level control strategies. Evaluate algorithms against existing state of the art, and demonstrate the biological system basis for the strategies. Identify target autonomous systems that could adopt resulting algorithms. Deliverables will include software (source code) and technical reports, and the Phase II final report with recommendations for transitioning the algorithms to operational systems.

PHASE III DUAL USE APPLICATIONS: The DoD has considerable interest in ensuring successful interoperation of autonomous systems (and systems of such systems) in joint operations with partner nations. Therefore, the goal during Phase III will be on transitioning algorithms to specific platforms and their respective programs of record, as well as transitioning the software framework for testing control strategies for use in laboratory environments. This will entail development of application-specific software, hardening the algorithms, and ensuring performance on application-specific hardware as well as in real-world and real-time environments.

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KEYWORDS: autonomous systems, swarms, control theory, bio-inspired computing, emergent behavior, animal models, self-organizing systems, artificial intelligence

SB162-006 TITLE: Innovative Technologies for High Power Amplification at THz frequencies

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Electronics, Sensors

OBJECTIVE: Investigate and demonstrate an innovative and radical approach capable of revolutionizing technologies for high power amplification at terahertz (THz) frequencies.

DESCRIPTION: Vacuum electronic and solid state high power amplifiers are important technologies for a wide range of military, civilian, and commercial applications. Vacuum electronic amplifiers are based on electron beam transport in vacuum and are capable of high power amplification (gain over 40 dB), output power in the kW range, wide bandwidth (multi-octave), high reliability (100,000 hours), high efficiency (up to 90% with depressed collector), high radiation tolerance, and efficient heat dissipation. Solid state amplifier technologies are based on electron beam transport in semiconductors and tend to have higher reliability (one million hours), but with reduced

output power in the range of tens to hundreds of watts and efficiency as high as 40% at microwave frequencies and below. Solid state technologies also exhibit less efficient heat dissipation that contributes to increased system size, weight, and power. Significant progress continues to be demonstrated in both technologies towards higher operating frequencies, bandwidth, and efficiency, although vacuum electronic devices still maintain an edge in applications requiring high power and efficiency at the highest frequencies.

The worldwide availability and proliferation of inexpensive, high power commercial amplifiers and sources has made the electromagnetic spectrum crowded and contested in the RF and microwave regions. The wealth of technical advantages offered by operating at higher frequencies, most notably the wide bandwidths available, are pushing both commercial and DoD solid-state and vacuum electron devices into the millimeter wave (mm-wave) region and beyond. However, pushing device operation to THz frequencies results in significant degradation in performance as the device dimensions decrease proportionally. For vacuum electronic amplifiers, the performance degradation is due to the constrained electron beam that must pass through much reduced interaction structures, as well as the challenging manufacturing and alignment tolerances. Similarly, solid state amplifier technologies suffer scaling challenges of their own that significantly limit their performance.

Researchers have demonstrated vacuum electronic amplifiers operating at 850 GHz with output power above 50 mW, 15 dB gain, and 11 GHz of bandwidth; and solid state amplifiers operating at 1 THz with output power to several milliwatts, 10 dB gain, and 90 GHz of bandwidth. However, the approaches demonstrated for both technologies are reaching their physical limits at THz frequencies. DARPA is seeking radical and innovative new approaches to fundamentally challenge the limitations imposed on power amplifier technologies at THz frequencies. At a minimum this approach will enable and enable, at the minimum, 1 W output power, 10 dB gain, 10% bandwidth, 50% power efficiency, and predicted reliability of one million hours; all in a reduced form factor for a single amplifier device. The proposed solution will provide technological advantage to military and commercial systems through increased accessibility to the regions of the electromagnetic spectrum that currently are unexplored.

The proposed approach must address all aspects of amplifier technology, including power supply and thermal management, necessary to demonstrate capabilities for high performance in a compact form factor at operating frequencies beyond 1 THz. Proposals must identify risks associated with the proposed innovative approach and present a thorough risk mitigation plan.

PHASE I: Demonstrate the feasibility of an innovative device concept capable of high power amplification enabling, at a minimum, operation at 1 THz with 1 W output power, 10 dB gain, 10% bandwidth, 50% power efficiency, and predicted reliability of one million hours from a single, compact device. Proposers will develop the initial concept design, identify key elements of the technology that will enable high performance, and perform complete analysis of the design using full-wave electromagnetic modeling and simulation. Deliverables will include a Phase I final report including a detailed plan for demonstrating a hardware prototype that can meet the performance metrics listed above.

PHASE II: Fabricate and test a single unit hardware prototype based on the Phase I concept and demonstrating the threshold performance targets. Develop and demonstrate the feasibility of concepts to extend the performance of the device to meet objective performance targets of operation at 1.5 THz with 10 W output power, 20 dB gain, 67% bandwidth, 50% power efficiency, and predicted reliability of one million hours from a single, compact device. Deliverables will include a Phase II final report including complete documentation of the prototype test results, a detailed plan for demonstrating a hardware prototype that can meet the performance metrics listed above, along with applications and prospective partners for technology transfer in Phase III.

PHASE III DUAL USE APPLICATIONS: Achieve a technology readiness level sufficient to support transition to military, civilian, and commercial applications for high power amplifiers (typically TRL 6). A successful Phase III development will demonstrate a hardware prototype based on Phase II design and meeting the objective performance targets and deliver the prototype with complete documentation to a commercial transition partner for applications in communications and sensing.

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KEYWORDS: Beam-wave interaction structure, beam collector, electron source, vacuum electronics

SB162-007 TITLE: Integrated Interface Layer for Micromagnetics and RF Computational Engines

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Information Systems

OBJECTIVE: Create a Graphical User Interface (GUI) with integrated pre- and post-processors that interface with efficient and accurate nonlinear micro-magnetic computation engines and allow rapid virtual prototyping of nonlinear magnetic components within standard RF design tools.

DESCRIPTION: There is a critical DoD need for capabilities that would provide improved interface of nonlinear micro-magnetic computation engines with standard RF design tools. Electromagnetic modeling and simulation engines are indispensable tools that enable rapid prototyping of components and systems. Linear magnetic behavior of components, such as circulators and oscillators, is efficiently and accurately modeled using any of a variety of standard RF computational engines, including circuit simulators such as Keysight Advanced Design System (ADS) and SPICE. However, these RF computational engines become inefficient and inaccurate for nonlinear and time-dependent magnetic behaviors, thus excluding magnetic components with those signal processing capabilities from the components inventory of RF design engineers. Some of the nonlinear magnetic components of potential value to many RF design engineers include frequency selective limiters (FSL) and signal-to-noise enhancers (SNE), which are self-adaptive (frequency and amplitude) notch and bandpass filters, respectively. Accurate and efficient modeling of the nonlinear and time-dependent magnetic behavior of components such as FSLs and SNEs requires micromagnetics computation engines that operate at the fundamental materials level, which are relatively of insignificance to RF design engineers. In addition, micromagnetics tools are not designed to interface with any specific RF computation engine and tend to produce output data that can be difficult to interpret. This renders micromagnetics tools impractical to RF design engineers and restricts their use, and thus the adoption of self-adaptive components. This impediment can be eased with a user interface capable of interfacing efficiently with both micromagnetics and RF computational engines. As such, this topic calls for innovative solutions for a Graphical User Interface (GUI) with integrated pre- and post-processors that gives the operator an efficient means to set up modeling and simulation problems and scenarios, which includes nonlinear magnetic components, and provides a vehicle for visualization and intuitive interpretation of the simulation output data. The GUI should work with existing RF computation engines and be scalable and robust enough for commercial and military users.

PHASE I: Select one or more candidate RF computation engines and determine input and output data exchange requirements with a high level micromagnetics computation engine. Develop initial concept design for and identify key elements of a GUI with integrated pre- and post-processors to generate input data and display output data for the candidate RF computation engines. Determine technical feasibility of integrating the proposed GUI with the selected computational engines. Deliverables will include a Phase I final report with draft use case, requirements, and

implementation documents supporting the proposed integration strategy.

PHASE II: Develop prototype GUI code and demonstrate the capability to generate input data and display output data with the selected RF computational engines. Demonstrate the capability to set up, analyze, and display a simple nonlinear magnetics component, such as an FSL, and validate the simulation results using experimental data or analytical results. Deliverables will include a Phase II final report, prototype GUI source code with complete use case, requirements, and implementation documents, and validation results showing the accuracy and efficiency of the prototype GUI.

PHASE III DUAL USE APPLICATIONS: Produce a fully integrated and optimized GUI, with complete technical and user documentation, supporting one or more selected RF computational engines using the prototype GUI source code from Phase II. Provide GUI source code to DoD laboratories for evaluation and testing. Demonstrate the capability to set up, analyze, and display results from a complex nonlinear magnetics component structure, which will accelerate the design cycle for components critical to electromagnetic communications and sensing applications in the commercial and military sectors.

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KEYWORDS: Electromagnetics, GUI, Micromagnetics, Modeling and simulation, RF circuit simulator

SB162-008 TITLE: Distributed Coherent Communications

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Air Platform

OBJECTIVE: Establish practical approaches to achieve distributed coherent communications between two disaggregated groups of RF communications nodes.

DESCRIPTION: There is a critical Department of Defense (DoD) need to create and exploit distributed coherent communications to enable future defense operations to make greater use of small, disaggregated, collaborative elements in contrast to larger elements. The challenge of communicating between clusters of such nodes becomes more acute as their size, weight, and power is reduced, in all environments (air, ground, maritime). The ability to create and exploit distributed coherent communications can be of great benefit to meeting these challenges. The reason for this is that a phase coherent array of n RF transmitters can enhance the power received at a distant receiver by a factor of n^2 relative to a single radio [1]. If the receiver also contains an array of m elements, a factor

of (n^2)m power gain can be achieved in one direction, and (m^2)n in the other direction. In a symmetric system, n^3 gain is possible. For example, a distributed coherent collection of 10 transmitters communicating to 10 receivers can ideally reduce the power required of a single transmitter by a factor of 1000. This project is aimed at maximizing the ability to exploit this phenomena.

In systems that are not physically connected, the separate challenges of 1) phase coherence between the transmitters, 2) RF channel state measurement, and 3) coordinated sharing of the information communicated must be resolved. While topics associated with coherent communications between groups of users and a centralized base station have been considered in the past, the case of communication between two disaggregated groups is more challenging [2,3,4]. Innovative and practically implementable solutions to these challenges are sought such that the size, weight, and power of the communicating clusters is minimized for a given data rate and operating frequency.

PHASE I: Develop an initial concept design and model key elements of all 3 challenges, and analyze the resulting communication systems properties. Phase 1 deliverables shall include a final report that contains design concept and architecture for a group to group communication system; results of simulation and modeling to establish system feasibility; and a plan for an experimental demonstration of a group to group coherent communication system.

PHASE II: Develop and demonstrate the efficacy of a distributed coherent communications system operating between two self-organizing clusters of nodes. An exemplary demonstration would include n airborne nodes over a variety of link ranges exhibiting n^(3/2) range enhancement relative to a single pair of nodes. Such a system will utilize a local network to establish and maintain communicating groups and to coordinate information transmission between the distant groups. A means for establishing and maintaining coherence among participating users and across groups will be developed. Groups of at least 3 members will be shown, with a preferable goal of 10 group members. Groups shall be flexibly assembled and members may join and leave the assembly in an ad hoc fashion. Phase 2 deliverables shall include the demonstration event, the hardware and software used to effect it, and final report describing the results, a comparison to theoretical expectations, identification of steps needed for further maturation of the technology and open issues or challenges to taking them.

PHASE III DUAL USE APPLICATIONS: Emergency responders often have a need to communicate in challenging conditions where conventional cellular communication infrastructure may be damaged or destroyed. In such conditions, the ability to communicate between disparate groups of radio-equipped users may be essential. The use of reach-enhancing techniques may be essential in these conditions.

Ad hoc communicating clusters of airborne nodes can be used to reduce power demands of autonomous unmanned aircraft systems (UAS) swarms or other collections of small disaggregated sensors. In such environments, small, affordable, stand-in platforms may be called upon to communicate results of intelligence, surveillance, and reconnaissance information. The use of distributed coherent group-to-group communications methods may significantly reduce the size, weight, and power burden that would otherwise be required on a single platform. A similar need arises for separated groups of soldiers communicating in austere environments.

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KEYWORDS: multiple-input, multiple-output (MIMO), coherent communications, RF systems, data links

SB162-009 TITLE: Software/Analytics Exploiting Commercial Satellite Imagery

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Direct to Phase II Instructions for DP2 requirements and proposal instructions.

NOTE: DARPA is accepting proposals from firms that are majority-owned by multiple venture capital operating companies in addition to other eligible firms. This authority ONLY applies to topic SB162-009 and supersedes Section 4.4 of the DoD SBIR FY16.2 Program Solicitation. The solicitation closing time for this topic has been extended to July 6, 2016 at 6:00 a.m. ET. In addition, the online SITIS Q&A System will be available for submission of technical questions for topic SB162-009 ONLY until June 22, 2016, at 12:00 Midnight ET.

TECHNOLOGY AREA(S): Information Systems, Sensors

OBJECTIVE: Develop and demonstrate innovative methods to for leveraging commercially-available satellite imagery data for use in national security applications.

DESCRIPTION: There is a critical DoD need for improved large scale situational awareness that can be addressed by leveraging the growing availability of public and commercial satellite imagery and sensor data. Access to commercial and public satellite imagery and sensor data enables the development of data analytics applications throughout the public and private sectors. Users are able to monitor weather events, crop growth, natural resource harvesting (e.g., mining and logging), urban growth, and many other natural and human-driven activities worldwide. In many cases, data is available with little delay between observation and data delivery. The data can be used for time critical applications such as natural disaster impact predictions and assessments as well as near- and long-term applications such as famine prediction, regulatory and international law compliance assessment, new infrastructure demand evaluation, food and natural resource availability assessment, and regional stability evaluation.

The same commercial and public satellite imagery and sensor data may also be beneficial for DoD and national security related applications, particularly when used to augment other data. Commercial satellite imagery combined with other intelligence can support international drug interdiction, maritime security, and treaty compliance. Further, the use of unclassified satellite imagery and data enables greater sharing of analysis products with non-DoD US agencies and coalition partners for conducting joint operations.

PHASE I: Develop a system concept and software architecture for applications of commercial and public satellite imagery and sensor data for DoD, US interagency, and/or US-supported coalition missions. Develop algorithmic approaches that enable monitoring, prediction, and assessment capabilities for the selected application or mission. Identify metrics, constraints, and performance levels needed for supporting the selected applications and missions, including data distribution approaches. Develop and demonstrate a limited-functionality prototype of the software system. Applications may use a single data source/type (e.g., imagery) or a combination of sources/types. Phase I deliverables shall include a final report that describes the system concept and software architecture, algorithms, and experiment and demonstration data.

PHASE II: Develop, demonstrate, and validate a prototype software solution. The prototype should focus on information collection, analysis, and analysis product dissemination at the appropriate time scales. Conduct tests of the system (software, data collection and distribution, etc.) to show performance relative to established metrics and associated requirements (processing, data access/exchange, and networking) for a deployed application. Phase II deliverables shall include a final report that contains the final system and software architecture, a prototype that has been tested in a realistic environment, test and measurement data, and system functionality and performance analysis.

PHASE III DUAL USE APPLICATIONS: Commercial applications: System architecture and software enabling information collection, analysis, and analysis product dissemination at the appropriate time scales required for application support.

DoD/Military applications: Ability to support DoD, US interagency, and/or US-supported coalition missions.

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KEYWORDS: satellite imagery, geographic information systems, data analytics

Certification for Applicants that are Majority-Owned by Multiple Venture Capital Operating Companies, Hedge Fund or Private Equity Firms (SBA Policy Directive 2014, page 47, Certifications)

Any small businesses that is majority-owned by multiple venture operating companies (VCOCs), hedge funds or private equity firms and are submitting an application for and SBIR funding agreement must complete this certification prior to submitting an application. This includes checking all of the boxes and having an authorized officer of the applicant sign and date the certification each time it is requested.

Please read carefully the following certification statements. The Federal government relies on the information to determine whether the business is eligible for a Small Business Innovation Research (SBIR) Program award and meets the specific program requirements during the life of the funding agreement. The definitions for the terms used in this certification are set forth in the Small Business Act, SBA regulations (13 C.F.R. Part 121), the SBIR Policy Directive and also any statutory and regulatory provisions referenced in those authorities.

If the funding agreement officer believes that the business may not meet certain eligibility requirements at the time of award, they are required to file a size protest with the U.S. Small Business Administration (SBA), who will determine eligibility. At that time, SBA will request further clarification and supporting documentation in order to assist in the verification of any of the information provided as part of a protest. If the funding agreement officer believes, after award, that the business is not meeting certain funding agreement requirements, the agency may request further clarification and supporting documentation in order to assist in the verification of any of the information provided.

Even if correct information has been included in other materials submitted to the Federal government, any action taken with respect to this certification does not affect the Government's right to pursue criminal, civil or administrative remedies for incorrect or incomplete information given in the certification. Each person signing this certification may be prosecuted if they have provided false information.

The undersigned has reviewed, verified and certifies that (all boxes must be checked):

(1) The applicant is NOT more than 50% owned by a single VCOC, hedge fund or private equity firm.

☐ Yes ☐ No

(2) The applicant is more than 50% owned by multiple domestic business concerns that are VCOCs, hedge funds, or private equity firms.

☐Yes ☐No

(3) I have registered with SBA at www.SBIR.gov as a business that is majority-owned by multiple VCOCs, hedge funds or private equity firms.

☐Yes ☐No

☐ I understand that the information submitted may be given to Federal, State and local agencies for determining violations of law and other purposes.

☐ All the statements and information provided in this form and any documents submitted are true, accurate and complete. If assistance was obtained in completing this form and the supporting documentation, I have personally reviewed the information and it is true and accurate. I understand that, in general, these statements are made for the purpose of determining eligibility for an SBIR funding agreement and continuing eligibility.

☐ I understand that the certifications in this document are continuing in nature. Each SBIR funding agreement for which the small business submits an offer or application or receives an award constitutes a restatement and reaffirmation of these certifications.

☐ I understand that I may not misrepresent status as small business to: 1) obtain a contract under the Small Business Act; or 2) obtain any benefit under a provision of Federal law that references the SBIR Program.

☐ I am an officer of the business concern authorized to represent it and sign this certification on its behalf. By signing this certification, I am representing on my own behalf, and on behalf of the SBIR applicant or awardee, that the information provided in this certification, the application, and all other information submitted in connection with this application, is true and correct as of the date of submission. I acknowledge that any intentional or negligent misrepresentation of the information contained in this certification may result in criminal, civil or administrative sanctions, including but not limited to: (1) fines, restitution and/or imprisonment under 18 U.S.C. §1001; (2) treble damages and civil penalties under the False Claims Act (31 U.S.C. §3729 *et seq*.); (3) double damages and civil penalties under the Program Fraud Civil Remedies Act (31 U.S.C. §3801 *et seq*.); (4) civil recovery of award funds, (5) suspension and/or debarment from all Federal procurement and nonprocurement transactions (FAR Subpart 9.4 or 2 C.F.R. part 180); and (6) other administrative penalties including termination of SBIR/STTR awards.

Signature	*Date__ /__ /__*
Print Name (First, Middle, Last)	
Title	
Business Name	

SB162-010 TITLE: Near-Photon-Counting, High Dynamic Range, Passive Vision Detector Arrays

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Sensors

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

OBJECTIVE: Develop low-light passive imaging sensor technologies based on Linear-mode (Lm) and/or Geiger-mode (Gm) avalanche photodiode (APD) technologies.

DESCRIPTION: This effort will explore Lm and/or Gm APD techniques for a near-photon-counting near infrared (NIR) and/or short wave infrared (SWIR) sensor. The low-light imaging sensor should operate in bright sunlight with a large single-detector instantaneous field-of-view (IFOV), and also operate at night with very low ambient light, with sensitivity better than current night vision and low-light sensors by several orders of magnitude. DARPA is interested in developing a photon counting sensor detector array for passive imaging with incoherent illumination, operating in either the linear mode or Geiger mode. The minimum desired array size is 128x128 detectors, and the array technology should be capable of scaling up to 1028x1028 detectors. The array should be capable of passive light detection at frame rate > 30 Hz. The detectors should have an avalanche gain > 100, with an excess noise factor < 2. The sensor should be capable of storing 10 or more range returns per angle/angle pixel when in a receiver mode. Detector pitch should be 50 μm x 50 μm or smaller. The detectors should come as close as possible to detecting 1 photon with a high detection probability and a low false alarm rate. The detectors should have bandwidth > 500 MHz. The detector array should be capable of a FOV > 35 x 35 degrees in bright sunlight in the 800-1200 nm and/or 1500 -1600 nm bands, using passive direct detection with a narrow band filter that is > 3 nm in width. More angle/angle pixels will reduce the need to handle high background radiation in a particular detector. One of the goals of this effort is a passive imaging sensor with high dynamic range in the presence of high daylight background illumination. Another goal is a passive imaging sensor that also has high sensitivity at night with very low ambient flux. The sensor should be capable of incorporating a narrowband filter for operation with active laser illumination, and also a much broader wavelength filter for passive operation. In order to allow the possibility of coherent sensor operation with a strong local oscillator (LO), the sensor readout should be AC coupled or provide some other readout method so the detector dynamic range through narrowband filer or wideband filer operation is not significantly reduced when a strong LO is used. The sensor should be capable of integration into a compact and inexpensive imaging system with minimal required cooling/temperature control hardware.

PHASE I: Develop a detailed description of the detector array and photon counting imaging sensor system capable of operating in NIR or SWIR bands, and should result in a description of the low light imaging performance under extreme low light conditions, a description of the dynamic behavior and electrical properties of the sensor system and a preliminary evaluation of the expected size, weight, and power consumption of a prototype implementation. Phase 1 should address the ability of the proposed approach to operate in bright sunlight with only a moderately narrowband filter and a wide FOV, and should estimate how many photons at a single detector pixel would be required for 90% probability of detection (PD). A single pixel should generate false detections at rate < 1 per minute, and an object which aggregates > 60 pixels should generate a false object detection at rate < 1 per hour.

PHASE II: Demonstrate the Phase I concept via laboratory breadboard experiments. In Phase 2, a Phase 1 concept will be reduced to practice and performance validated in a laboratory setting. The experiments conducted should result in empirical and/or analytic knowledge that is used to design a preliminary prototype sensor. The laboratory brassboard must provide characterization data that demonstrate by analysis that the performance objectives can be met. The preliminary design should focus on a demonstration system which could be utilized in a field experiment and would directly meet the performance objectives.

PHASE III DUAL USE APPLICATIONS: The Phase 3 effort should build the preliminary prototype sensor and conduct a field demonstration meeting the performance objective. A Phase 3 demonstration could be applied to a number of commercial applications, including for example: 1) An automobile day/night passive sensor for a driverless car, 2) a lidar sensor for measuring body motions in interactive computer games, and 3) compact day/night passive or active (i.e. lidar) surveillance systems for robotics and/or security. A commercially-focused Phase 3 effort could choose a viable commercial use and build a prototype system optimized for that application.

The Phase 3 effort for DOD application should result in development of an extremely sensitive and flexible

integrated day and night capable 2D/3D vision system that will be able to operate in full day light and extreme low light conditions seamlessly. Additionally, the Phase 3 effort will fill the large need for Unmanned Aerial Vehicle (UAV) sensors, and sensors for robots that require full daylight and extreme low light operations. The Phase 3 effort will be able to fabricate short range, inexpensive, relatively wide FOV sensors in large quantities. The Phase 3 effort should provide advanced passive and active low light imaging sensor options that also can be used with other 3D lidars, UAVs, and robots. Example tasks with military application for these systems may include day/night autonomous navigation, night time surveillance, terrain mapping, and improved night vision for vehicle operators and ground troops.

REFERENCES:
1. J. E. Carey and J. W. Sickler, "IR Detectors: Black silicon sees further into the IR", Laser Focus World, Aug 01, 2009

2. T. Vogelsong; J. Tower; T. Senko; P. Levine; J. Janesick; J. Zhu; D. Zhang; G. van der Wal; M. Piacentino, "Low-light NV-CMOS image sensors for day/night imaging", Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications X, SPIE Vol. 87130F (31 May 2013)

3. Boyd Fowler, Chiao Liu, Steve Mims, Janusz Balicki, Wang Li, Hung Do, and Paul Vu, "Low-Light-Level CMOS Image Sensor For Digitally Fused Night", SPIE Defense Security and Sensing, SPIE Vol. 7298-49

4. P. F. McManamon, Chair, W F. Buell, co-chair, et al, "Laser radar, Progress and Opportunities in Active EO sensing", National academy of sciences report, International Standard Book Number-13: 978-0-309-30216-6 International Standard Book Number-10: 0-309-30216-1

5. Optical Detection Theory for Laser Applications, G. R. Osche, Wiley-Interscience, New York (2002).

KEYWORDS: Low Light Imaging Sensor, Low Light Receiver, Avalanche Photo Diode, APD, Linear mode APD, LMAPD

SB162-011 TITLE: Distributed, Large Scale Spectrum Measurement and Analysis

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Electronics, Information Systems

OBJECTIVE: Develop and demonstrate innovative methods to collect, process, and analyze RF spectrum measurements made from a large number (50 or greater) of mobile collection platforms (at low altitude and/or close to the emitters) to obtain useful information on spectrum use and activities.

DESCRIPTION: There is a critical DoD need to obtain radio operations information using spectrum measurements. The Internet of Things devices and the proliferation of low power communication devices are becoming an increasing factor in wireless operations. Many of these systems use directional signals and operate at high frequencies. These factors make these signals unobservable at large standoff distances. In cases where these signals are detectable, the number of signals detected tends to overwhelm any signal processing system.

It is of interest to use large (10s to 100s) numbers of small, low cost platforms to carry a small spectrum collection and processing sensor to provide distributed, wide area coverage for spectral sensing and radio operation understanding. This would solve both the problems of making an individual system "disposable" and detecting weak signals possible. There are other advantages such as spatial diversity detection (receiving signals simultaneously from many spatial angles), location diversity (seeing signals from many locations), etc. The platforms of interest can

include airborne and ground platforms.

The challenge is that a mobile platform near a transmitter or flying at low altitudes (to avoid detection) measures a signal with rapidly varying amplitudes and small detection distance. Combining these problems with uncertain or unknown transmitter parameters (duty cycle, antenna pointing angle, antenna beam motion, waveform agility, etc.) makes mobile platform spectrum data interpretation very difficult. Another challenge is that small mobile platform sensors have limited spectrum scan rate, processing, and backhaul capabilities. These limitations need to be managed to achieve useful mission selectable goals.

PHASE I: Develop a system design concept, including the sensor platform, networking approach, and application functionality. Perform technology risk reducing experiments and demonstrations of system components if possible. Develop algorithms and software to enable obtaining useful information on transmitters (characteristics, locations, mobility, etc.) from the distributed measurements.

PHASE II: Develop, demonstrate, and validate a prototype distributed mobile spectrum measurement system. The prototype should focus on mobile airborne platforms, but the demonstration may involve live ground platforms along with emulated data from airborne sensors for cost efficient tests. The demonstration should include real and emulated sensors to show scalability (goal of 50 nodes).

PHASE III DUAL USE APPLICATIONS: Commercial applications: Continue to mature the design by adding features to meet requirements for commercial applications in spectrum monitoring and enforcement in industries such as telecommunications and broadcasting. The testing should include common commercial UAV platforms.

DoD/Military applications: Continue to mature the design by adding features to meet more military requirements, including testing on common military unmanned and manned airborne platforms. Investigate the potential for transitioning portions of the technology to existing programs of record.

REFERENCES:
1. Mark A. McHenry, Peter A. Tenhula, Dan McCloskey, Dennis A. Roberson, and Cynthia S. Hood. 2006. Chicago spectrum occupancy measurements & analysis and a long-term studies proposal. In Proceedings of the first international workshop on Technology and policy for accessing spectrum (TAPAS '06). ACM, N

2. SiXing Yin; Dawei Chen; Qian Zhang; Mingyan Liu; ShuFang Li, "Mining Spectrum Usage Data: A Large-Scale Spectrum Measurement Study," Mobile Computing, IEEE Transactions on, vol.11, no.6, pp.1033,1046, June 2012.

3. da Silva, C.R.C.; Choi, B.; Kyouwoong Kim, "Distributed Spectrum Sensing for Cognitive Radio Systems," Information Theory and Applications Workshop, 2007, pp.120,123, Jan. 29 2007-Feb. 2 2007.

KEYWORDS: communications, sensors, electromagnetic spectrum, jamming, electronic warfare, signals intelligence

SB162-014 TITLE: Light-weight and Low Cost Composite Cryotank

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Air Platform, Space Platforms

OBJECTIVE: Develop high-performance, lightweight composite cryogenic propellant tanks suitable for use on expendable and reusable space access vehicles and hypersonic aircraft.

DESCRIPTION: While advancements in composite pressure-vessel technology have allowed the fabrication of composite cryogenic propellant tanks, the state of the art falls far short of what is currently possible with propellant

tanks in terms of performance and reusability.

Existing graphite-fiber composite-pressure vessels can safely operate without leaks with multi-axis strain levels in excess of 15,000 microstrain, however conventional graphite-fiber composite cryotanks tend to operate at less than 5,000 microstrain [Ref 1]. This means that these cryotanks tend to be three times heavier than a pressure vessel designed for the same operating pressure. Achieving 15,000 microstrain in a graphite-fiber composite cryotank would offer the capability to achieve tank weight/volume that is far less than the metal cryotanks currently in use in space launch vehicles [Ref 2], enabling improved vehicle performance and payload delivery.

In this effort, DARPA seeks very low-cost and lightweight composite cryotanks that offer substantially better cost and weight/volume than state-of-the-art tanks. The target performance is to achieve a recurring production cost of less than $1,000/ft3 internal volume and less than 0.50 lbm/ft3 (weight of tank/volume of tank) performance in a reference cryotank that is 6 ft. in diameter with a volume of 350 ft3, assuming a minimum burst of 120 psi, not including structural load bearing skirt extensions. The cryotank needs to remain leak-tight after repeated cryogenic temperature and pressure cycles, with a minimum threshold of 25 combined cycles and a goal of more than 1,000 combined cycles. The cryotank must be capable of operating with common rocket propellants, with a minimum threshold of liquid oxygen (LOX), RP-1 and liquid methane containment capability and a goal of liquid hydrogen capability.

PHASE I: Experimentally demonstrate the capability of a thin graphite-fiber composite laminate to remain leak-tight when subjected to repeated multi-axis strain and thermal cycles. Specifically, the testing would need to demonstrate leak-tight capability after at least ten combined thermal (less than LOX temperature) and multi-axis strain (greater than 15,000 microstrain) cycles. Using test results, develop a conceptual design of a cryotank that would demonstrate the weight/volume goal for the reference tank requirements. Show how the cryotank could be adapted to include structural load-bearing capability and assess the performance impact.

PHASE II: Design, analyze and fabricate cryotanks that meet the reference tank requirements. Test the cryotank to verify that it achieves the weight/volume goal and remains leak-tight after more than the threshold number of combined thermal (at liquid nitrogen (LN2) temperature) and pressure cycles (design operating pressure).

PHASE III DUAL USE APPLICATIONS: Achieving the composite cryotank cost and weight/volume performance goals cited in phase 2 and 3 above offers the means to reduce launch vehicle mass and increase launch vehicle payload while reducing cost. Achieving the combined cycle goal would provide this performance advantage to reusable vehicles, thereby reducing launch costs. The technology is directly applicable to follow on reusable vehicles to DARPA's Experimental Spaceplane (XS-1) program, as well as next-generation global reach and advanced hypersonic aircraft.

This technology would support a wide range of commercial launch vehicles being pursued today, both expendable and even a few reusable vehicle concepts. The technology would also support advanced hypersonic aircraft and airborne laser systems as well as liquefied natural gas transportation systems.

REFERENCES:
1. Stokes, E., "Hydrogen Permeability of a Polymer Based Composite Tank Material Under Tetra-Axial Strain," 5th Conference on Aerospace Materials, Processes, and Environmental Technology (AMPET), September 16 -18, 2002

2. Sleight, D, et al, "Structural Design and Sizing of a Metallic Cryotank Concept," 54th AIAA/ASME/ASCE/AHS/ASC, Structures, Structural Dynamics, and Materials Conference; April 8-11, 2013

KEYWORDS: Additive Manufacturing, Liquid Rocket Engines, Launch Vehicle, Spacecraft Propulsion

SB162-015 TITLE: Autonomous Detection of Near-Surface Marine Mammals

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 16.2 DoD Program Solicitation and the DARPA 16.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREA(S): Ground/Sea Vehicles, Sensors

OBJECTIVE: Develop and demonstrate a reliable autonomous methodology to detect, localize and identify presence of marine mammals from transiting surface ships at ranges up to 1,000 yards. Investigate and validate the necessary combination of sensors, software and computing to achieve this desired objective.

DESCRIPTION: Under the provisions of the Marine Mammal Protection Act, and as good stewards of the natural environment, it is incumbent on all U.S. mariners, including operators of DoD vessels, to avoid strikes and "near misses" of whales and other mammalian species. Current methods of performing this task primarily rely on human watchstanders using binoculars. This is less than ideal even in conditions of good visibiltiy, since humans are subject to fatigue and inattention, and marine mammals may only surface for fleeting periods of time. In conditions of poor visibility, the potential for overlooking presence of mammals increases. It is possible that automated solutions, either instead of or in addition to human observers, may be more effective than current methods.

This SBIR seeks to derive innovative marine mammal detection solutions to establish autonomous means of:
• Marine mammal identification to abate vessel strike of transiting ships
• Marine mammal mitigation zones around each vessel using sonar
• Reducing inherent human error for accurate detection of marine mammals

PHASE I: Determine technical feasibility of detecting and identifying marine mammals from a transiting surface ship using best-of-breed sensors and processing. Investigate available spectrum of most-effective active and passive sensors to discriminate a marine mammal from other natural sea clutter.

Determine the technical feasibility of automating the detection and identification of marine mammals using the detection methodology specified above.

Phase I deliverables shall include analysis of alternatives of sensor(s) detection methodology with recommended solution. Additional deliverable is analytical (algorithm development) approach and study to achieve autonomous and reliable marine mammal detection and identification.

PHASE II: Finalize Phase I deliverables into an engineering design, including software development plan. Demonstrate and validate detection and identification of marine mammals from a transiting surface ship using Phase I-derived sensor(s) and processing.

Phase II performance metrics shall be achieved through construction of engineering prototype sensor(s) suite to collect specific data required to validate marine mammal detection and identification algorithms.

The complex sensor-processing Phase II solution shall demonstrate the ability to discriminate a marine mammal from other natural sea clutter.

Phase II deliverables shall include refined analysis methodology with recommended Phase III demonstration. Additional deliverable is analytical (algorithm development) approach and study to achieve autonomous and reliable marine mammal detection and identification.

PHASE III DUAL USE APPLICATIONS: The sensor system and software developed in this topic could be packaged to provide a marine mammal warning and avoidance system for commercial vessels, reducing the incidence of marine mammal strikes and near misses, aiding commercial operators in their obligations under the Marine Mammal Protection Act.

REFERENCES:

1. The Marine Mammal Protection Act of 1972 as Amended.

KEYWORDS: Autonomous, Detection, Marine Mammals, Sensor, Processing