DARPA

SBIR 15.2 DIRECT TO PHASE II PROPOSAL INSTRUCTIONS

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DARPA DIRECT TO PHASE II (DP2) PROPOSAL INSTRUCTIONS

TABLE OF CONTENTS

IMPORTANT NOTE REGARDING THESE INSTRUCTIONS 1
1.0 INTRODUCTION 1
Direct to Phase II (DP2) 1
System Requirements 2
3.0 DEFINITIONS 2
3.4 Export Control 2
3.5 Foreign National 3
4.0 PROPOSAL FUNDAMENTALS 3
4.6 Classified Proposals 3
4.7/4.8 Human and/or Animal Use 3
4.10 Debriefing 4
Notification of Proposal Receipt 5
Notification of Proposal Status 5
4.11 Solicitation Protests 5
4.14 DP2 Award Information 5
4.15 Questions/Information 6
4.22 Discretionary Technical Assistance (DTA) 6
7.0 DP2 PHASE II PROPOSAL 7
7.1 Introduction 7
7.2 Proposal Provisions 7
7.4 Commercialization Strategy 7
DP2 PROPOSAL INSTRUCTIONS 9
Appendix Format 12
Modifications or Withdrawal of Proposals 13
DP2 PROPOSAL CHECKLIST 13
8.0 PHASE II EVALUATION CRITERIA 14
Advocacy Letters 15
Limitations on Funding 15
11.0 CONTRACTUAL CONSIDERATIONS 15
External Certification Authority (ECA) 15
Security Requirements 15
Payment Schedule 15
11.4 Patents 16
11.5 Intellectual Property Representations 16
11.1 (r) Publication Approval (Public Release) 16
11.7 Phase II Reports 16
12.0 DARPA SBIR 15.2 TOPIC INDEX 17
DARPA SBIR 15.2 TOPIC DESCRIPTIONS 17

IMPORTANT NOTE REGARDING THESE INSTRUCTIONS

THESE INSTRUCTIONS ONLY APPLY TO PROPOSALS SUBMITTED IN RESPONSE TO DARPA 15.2 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 15.2 DoD Program Solicitation (http://www.acq.osd.mil/osbp/sbir/index.shtml).

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/Opportunities/SBIR_STTR/SBIR_STTR.aspx

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 15.2 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.

DEADLINE FOR 15.2 DP2 PROPOSALS: 6:00 AM (ET) on June 24, 2015.

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 15.2 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 http://travel.state.gov/law/citizenship/citizenship_782.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://www.darpa.mil/WorkArea/DownloadAsset.aspx?id=2147486611 to review the Human Use PowerPoint presentation to understand what is required to comply with human protocols and http://www.darpa.mil/WorkArea/DownloadAsset.aspx?id=2147486040 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 https://mrmc-www.army.mil/index.cfm?pageid=Research_Protections.acuro&rn=1.

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 during the Phase I project 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 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).
- More information on Other Transactions is available at: http://www.darpa.mil/Opportunities/Contract_Management/Other_Transactions_and_Technology_Investment_Agreements.aspx.

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)

Offerors that are interested in proposing use of a vendor for technical assistance must complete the following:

1. Indicate in question 17, of the Proposal Cover Sheet, 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 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. The proposed amount may not exceed $5,000 per year and a total of $10,000 per Phase II contract.

DTA requests must be explained in detail with the cost estimate. 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). Approval of technical assistance is not guaranteed and is subject to review of the Contracting Officer. Please see section 4.22 of the DoD Program Solicitation instructions 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)
  - APPENDICES (20 page maximum – will NOT be evaluated)
- 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 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 discussion should include identification of the problem, need, or requirement relevant to a Department of Defense application and/or a private sector application that the SBIR project results would address; a description of how wide-spread and significant the problem, need, or requirement is; and identification of the potential DoD end-users, Federal customers, and/or private sector customers who would likely use the technology.

Technology commercialization and transition from Research and Development activities to fielded systems within the DoD is challenging. Include transition and commercialization activities conducted during Phase I, and how the preliminary transition path or paths may evolve during the Phase II project. That plan should include the Technology Readiness Level (TRL) achieved at the end of the Phase I. The plan should include anticipated business model and potential private sector and federal partners the company has identified to support transition and commercialization activities. In addition, key proposed milestones anticipated during Phase II such as: prototype development, laboratory and systems testing, integration, testing in operational environment, and demonstrations.

At a minimum, your commercialization strategy must address the following five questions:

(1) What is the first product that this technology will go into?
(2) Who will be the customers, and what is the estimated market size?

(3) How much money will be needed to bring the technology to market, and how will that money be raised?
(4) Does the company contain marketing expertise and, if not, how will that expertise be brought into the company?
(5) Who are the offeror's competitors, and what is the price and/or quality advantage over those competitors?

The commercialization strategy must also include a schedule showing the anticipated quantitative commercialization results from the Phase II project at one year after the start of Phase II, at the completion of Phase II, and after the completion of Phase II (i.e., amount of additional investment, sales revenue, etc.). After Phase II award, the company is required to report actual sales and investment data in its Company Commercialization Report (see Section 7.5.e) at least annually.

In addition, each Phase II proposal must contain a five-page commercialization strategy as part of the Technical Volume, addressing the following questions:

(1) Product Description/System Application – Identify the Commercial product(s) and/or DoD system(s) or system(s) under development or potential new systems that this technology will be/or has the potential to be integrated into.
(2) Advocacy Letters** – Feedback received from potential Commercial and/or DoD customers and other end-users regarding their interest in the technology to support their capability gaps.
(3) Letters of Intent/Commitment** – 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.
(4) Business Models/Procurement Mechanisms/Vehicles – Business models, procurement mechanisms, vehicles and, as relevant, commercial channels, 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 the procurement mechanisms, vehicles and channels 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.
(6) What is the current size of the broad market you plan to enter and the "niche" market opportunity you are addressing?
(7) What are the growth trends for the market and the key trends in the industry that you are planning to target?
    a. What features of your technology will allow you to provide a compelling value proposition?
    b. Have you validated the significance of these features and if not, how do you plan to validate?
(8) Competition Assessment – Describe the competition in these markets/customer sets and your anticipated advantage (e.g., function, performance, price, quality, etc.)
(9) Funding Requirements – List your targeted funding sources (e.g., federal, state and local, private (internal, loan, angel, venture capital, etc.) 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
    - as required, mature the manufacturing processes
    - 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

(10) Sales Projections – Provide a schedule that outlines your anticipated sales projections and indicate when you anticipate breaking even.

(11) 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 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.)?

**Please note: 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.

1. After authenticating, choose "Phase II Proposal Preparation"
2. When asked to choose a Phase I proposal number, choose Z001

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. Additional details and explanations regarding the Cost Volume may be uploaded as an appendix to the Technical Volume. 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.

Appendix Format

An Appendix contains information that is non-essential to understanding of the proposal, but may present information that further clarifies a point without burdening the body of the Technical Volume. An Appendix is optional. Each Appendix should be identified by a Roman numeral in sequence, e.g., Appendix I, Appendix II, etc. Each Appendix should contain different material. The Appendix footer should contain the page number (following the sequence used for the entire proposal) and the Appendix label (ex. Appendix I). Please note, only that

information provided in the Technical Volume (pg. 1-40, including Cover Sheet, Cost Volume and CCR) will be considered by the evaluator. Evaluator review of any Appendix material is optional.

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).

  ____e. Appendices (OPTIONAL) do not exceed the 20 page maximum (appendices will NOT be evaluated).

  ____e.1. Appendix contains information that is non-essential to understanding of the proposal, but may present information that further clarifies a point without burdening the body of the Technical Volume.

  ____e.2. Each Appendix identified by a Roman numeral in sequence (e.g. Appendix I, Appendix II...). Each Appendix contains different material.

  ____e.3. The Appendix footer contains the page number (following the sequence used for the entire proposal) and the Appendix label (ex. Page 78: Appendix I).

____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

____ a. 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 6:00 AM (ET) on June 24, 2015.

____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 6:00 AM (ET) on June 24, 2015. 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."

Advocacy Letters

Please note that qualified advocacy letters will count towards the proposal page limit and will be evaluated towards criterion C. Advocacy letters are not required. Consistent with Section 3-209 of DoD 5500.7-R, Joint Ethics Regulation, which as a general rule prohibits endorsement and preferential treatment of a non-federal entity, product, service or enterprise by DoD or DoD employees in their official capacities, letters from government personnel will NOT be considered during the evaluation process.

A qualified advocacy letter is from a relevant commercial procuring organization(s) working with a DoD or other Federal entity, articulating their pull for the technology (i.e., what need the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. If submitted, the letter should be included as the last page of your technical upload. Advocacy letters which are faxed or e-mailed separately will NOT be considered.

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/NewsEvents/Public_Release_Center/Public_Release_Center.aspx 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.

Not all DARPA topics are eligible for a Direct to Phase II award. Potential offerors should read the topic requirements carefully. Topics may accept Phase I and Direct to Phase II proposals, Phase I proposals only, or Direct to Phase II proposals only – refer to the 15.2 Topic Index to review proposal types accepted against each topic. 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 instructions in the DARPA Direct to Phase II Solicitation Instructions.

12.0 DARPA SBIR 15.2 TOPIC INDEX

These instructions ONLY apply to Direct to Phase II (DP2) proposals. For Phase I, refer to the 15.2 DoD Program Solicitation for Phase I Topics and Proposal Instructions, and the DARPA 15.2 Phase I Instructions (http://www.acq.osd.mil/osbp/sbir/index.shtml).

		Proposals Types Accepted	
Topic Number	**Topic Title**	**Phase I**	**DP2**
SB152-001	Cell Free Platforms for Prototyping and Biomanufacturing	YES	NO
SB152-002	Cortical Modem Systems Integration and Packaging	YES	YES
SB152-003	Broadband Self-calibrated Rydberg-based RF Electric Field and Power Sensor	YES	YES
SB152-004	Many-Core Acceleration of Common Graph Programming Frameworks	YES	YES
SB152-005	Ovenized Inertial Micro Electro Mechanical Systems	YES	NO
SB152-006	Compact, Configurable, Real-Time Infrared Hyperspectral Imaging System	YES	YES
SB152-007	Depth Insensitive Pressure/Vector Sensor Arrays	NO	YES
SB152-008	Low Cost Expendable Launch Technology	YES	NO

DARPA SBIR 15.2 TOPIC DESCRIPTIONS

SB152-002 TITLE: Cortical Modem Systems Integration and Packaging

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 15.2 DoD Program Solicitation and the DARPA 15.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREAS: Electronics, Biomedical

OBJECTIVE: Design and fabricate Cortical Modem electro/optical systems that demonstrate low-power telemetry of neural data and power across the scalp, skull, and brain tissue using standard data protocols. The system should be integrated within a single state-of-the-art system-on-a-chip scale implantable package suitable for use in humans.

DESCRIPTION: The DoD has a critical need for breakthrough medical therapies to treat wounded warriors with multiple comorbidities of sensory organs. This topic seeks to integrate state-of-the-art electronics, packaging, and passivation technologies with the latest low-power data and power delivery semiconductor components in a single package. In other words, DARPA seeks to wirelessly bridge cortical neural activity sensing components within the skull to external computing and network systems, designing an effective "Cortical Modem" that connects human brains to computer equipment and networks in a direct analogy to early telephonic modems, which connected

computers to the ARPANET. DARPA is open to a multiplicity of system architectures that, first and foremost, demonstrate significant improvements in the scale of neural channel bandwidth from the current 100-signal demonstrations, but secondly, may span a wide spectrum of implementation strategies from high-bandwidth transmission systems with limited implantable computation capability, to implantable integrated analysis and compression systems coupled to a limited bandwidth telemetry systems.

Significant advances in the miniaturization and ever lower-power performance of electronic and photonic technologies have enabled critical developments in miniaturized communications products like cellular phones. However, the time lag between such advances and their adoption in the fields of neuroscience and neuro-engineering has, in many cases, grown to more than twenty years. With such large interface component feature sizes characteristic of the older technologies in common experimental use, the supporting interface electronics have now become one of the most significant and fundamental limits to their integration within human and animal bodies. For example, the Utah array features a 400 micrometer electrode pitch, a limitation compounded by the wet etch microfabrication technology available to the manufacturer. Note that this 400 micron feature size is representative of 1980s CMOS technologies, and is too coarse for interfacing with, for example, the visual cortex where neural pitch ranges from ten to thirty microns.

As the mobile computing industry continues to push miniaturization, functionality, and power-consumption requirements to their limits, so too is the field of neuroscience pushing ever closer to full-duplex single-neuron scale interfaces. With focused technology development and integration to build a Cortical Modem, the necessary critical electronics and packaging could be leveraged across the entire academic and corporate neuroscience ecosystem to result in dramatically accelerated advances in science and commercialization of neuroscience technologies. The goal of this topic is to develop cortical modem components that substantially improve the scale of signal transduction from the current 10x10 electronic probe arrays, as well as the scale of telemetry delivery of those signals. For reference purposes, one mm^3 volume of cortical tissue encloses approximately 100,000 neurons indicating an eventual need to both transduce and deliver wireless telemetry for as many as 10^7 independent neural channels.

Proposals should target the design and implementation of a COTS-based full duplex cortical interface component. Essential elements of this component include flexible direct electronic interfaces to neural activity, sensors and low power pre-processing circuitry to convert and encode neural sensor signals into formats that can be transmitted wirelessly across the skull, wireless telemetry suitable for safe use in humans, and power delivery electronics. Packaging must leverage state-of-the-art miniaturized single system-on-a-chip ceramic packaging that incorporates on-board wireless power reception and conditioning circuitry.

Critical to the design of the system is a careful power and link budget analysis to account for relevant FDA and FCC regulations. In addition, proposals should detail the intended components (i.e. make, model, and part numbers), their interface design, and the technical and mechanical specifications that will ultimately yield the lowest power, smallest form-factor, and highest signal-to-noise ratio and bandwidth system possible using COTS components. Critical systems integration challenges must be addressed explicitly in the proposal. Technical challenges and considerations include system power, transmission bandwidth, frequency and data rates, transmission protocols, optical wavelengths, etc. Offerors are to first uncover and understand the critical integration challenges that may limit the translation and commercial-viability of full-duplex cortical interfaces, and second to push the standards of integration by producing a first generation of truly miniaturized and implantable interface componentry, thereby accelerating innovation across the entire field of neuro-engineering. Industrial and military collaborators should then produce products and reach their first commercialization milestones on a similarly accelerated timeline.

Technical challenges may include:

- The development of a standard interface between a multiplicity of different neural sensing components and the data collection and transmission system.

- Maximizing the scalability and bandwidth-power product of both the internal neural sensing and external wireless data and power interfaces, but doing so within safe heat dissipation limits of the outer cortex and skull.
- The potential need for data translation and encoding components to minimize power requirements for transcranial data and power delivery.
- Establishing optimal trade-offs between physical, electronic, and data transmission specifications required to minimize the componentry bill of materials (BoM) and hence the size of the device that needs to be implanted.
- Sourcing state-of-the-art packaging and system-on-a-chip prototyping support
- Determining optimal bio-material passivation strategies and packaging materials limitations.
- Determining optimal power-bandwidth tradeoffs and scalability to support increasing sensory density, resolution, and sensitivity limitations.

PHASE I: Explore and determine the fundamental systems integration and packaging limitations (that are common across the entire neural interface field) in implementing a full-duplex read/write neural interface system that bridges data and power delivery across the human skull. Phase I deliverables: 1) Final Report that identifies the neural read/write signals modalities (not necessarily required to be the same); details the technical challenges relevant to the read and write signals within the deployment environment; quantifies the information limits to the system relative to the information input/output of the cortical area of interest; details component-level metrics for coping with the data and power requirements; describes integration process, system-level challenges; and a thorough business plan describing the NRE costs, minimum rate of production, units per year required to achieve sustainable production of a cortical modem, and market analysis; 2) Develop a fully-operational proof-of-concept demonstration of the key components and functional systems in a bench-top / PC-board scaled prototype along with all the design documents and complete specifications, along with documentation of committed sources and service providers for the fabrication of the ultimate integrated system-on-a-chip Cortical Modem device to be produced in Phase II; full specifications and a complete BoM are required, itemizing each component and system that comprises the final prototype system. These demonstrations should be performed in relevant in vitro environments analogous to the final deployment environment in the human skull and cortex.

PHASE II: Development, demonstration, and delivery of a working fully-integrated cortical modem at a 1:1 physical scale with the underlying neurons. The Phase II demonstration should operate within a physical simulacrum that mimics as closely as possible the electrical and mechanical properties of human cortex, skull, and scalp. The integrated system should leverage COTS silicon and electro-optical devices wherever possible, and form a data and power bridge between the internal cortex and external machines. On the cortex side, a modular neural interface architecture should support bi-directional communications through a multiplicity of neural probe modalities, including, but not limited to, optical, electronic, and bio-molecular sensing interfaces. The external interface should be comprised of a wireless interconnection through intervening brain and skull tissue to external computing systems. Proposers are encouraged to adapt modular componentry strategies that is generalizable to a wide range of neural interfaces. The Cortical Modem system should be able to collect and transmit neural signals through the skull in a complete, implantable package. It will have a form-factor and packaging that can be implanted in the cortex with core system functionality provided by COTS semiconductor components in a single ceramic system-on-a-chip package, rather than a fully-customized chipset. The Phase II final report shall include (1) full system design and specifications detailing the electronics and proof-of-concept neural interfaces to be integrated; (2) expected performance specifications of the proposed components in vivo; and (3) calculations of energy and link budget scalability to larger cortical regions.

DP2: Offerors interested in submitting a DP2 proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of this 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. Read and follow section 7.0 of the DARPA 15.2 DP2 solicitation instructions. 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 proposalDP2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE III: Breakthrough medical treatments for wounded warriors with multiple comorbidities of the sensory organs. Effective restoration sight, sound, smell, and vestibular sensation after massive head trauma. Breakthrough medical treatments for upper spinal cord injuries, enabling restoration of motor and sensory capability. Breakthrough medical treatments for diseases of sensory organs, providing sight and sound to treat indications not possible through use of current retinal prostheses and cochlear implants.

REFERENCES:

(1) Normann, Richard A., et al. "A neural interface for a cortical vision prosthesis." Vision research 39.15 (1999): 2577-2587.
(2) Ahuja, A. K., et al. "Blind subjects implanted with the Argus II retinal prosthesis are able to improve performance in a spatial-motor task." British Journal of Ophthalmology 95.4 (2011): 539-543.
(3) Wilson, Blake S., et al. "Better speech recognition with cochlear implants." Nature 352.6332 (1991): 236-238.

KEYWORDS: neurotechnologies, cortical, systems integration, optical, transduction, in vivo, brain-machine interfaces, photonic, prototype

SB152-003 TITLE: Broadband Self-calibrated Rydberg-based RF Electric Field and Power Sensor

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 15.2 DoD Program Solicitation and the DARPA 15.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREAS: Sensors, Electronics

OBJECTIVE: Develop a Rydberg-based broadband (1 GHz – 1 THz) self-calibrated electric field sensor, power sensor, or components with high-sensitivity capable of working in a strong electric field environment (>1 kV/m). The electric field-sensing device should also be capable of imaging sub-wavelength RF fields to verify and guide circuit and metamaterial design achieving better than 10 µm spatial resolution.

DESCRIPTION: There is a critical need for capabilities that will enable the DoD to have self-calibrated electric field and power sensors in the RF, microwave, and millimeter-wavelength regimes. This topic seeks the demonstration of a portable broadband (1 GHz – 1 THz) electric field, power sensor, or key components towards a device. The sensor should be capable of operating in greater than 1 kV/m electric fields as to be usable for high-energy DoD applications. The electric field and power measurements must be SI traceable to remove the need for the recalibration process. Furthermore, the electric field-sensing device should be capable of sub-wavelength imaging of RF electric fields with spatial resolutions exceeding 10 µm.

Many DoD and commercial applications critically rely on using calibrated electric field and power sensors in the RF, microwave, and millimeter-wavelength regimes. Currently no self-calibrated sensor exists in the 100 GHz – 1 THz frequency band. Typical detectors in the sub-THz frequency range are antennas which inherently perturb the field they are trying to sense, resulting in greater than 5% measurement errors. Antennas have the further limitation that they are narrow-band detectors. A SI-traceable sensor in the 1 GHz – 1 THz range would remove the need for costly recalibration of older devices and would replace many narrow-band antennas with a single low-SWaP device in a handheld package.

Quantum sensors based upon Rydberg atoms offer the potential of traceable calibration, high sensitivity, wide spectral coverage, and high power capability. In addition to DoD applications, a Rydberg field and power sensor would have numerous commercial applications: circuit design [1, 2], biological sensing [3], aeronautics applications [4], and mobile communication [5]. This technology would not only verify circuit design but inform it by employing

sub-wavelength RF field imaging of the complicated electronic fields from various dense circuits and metamaterials [1, 2].

Current technology employing electromagnetically induced transparency (EIT) in Rydberg atoms in an atomic vapor cell is a promising route but requires further development in order to achieve DoD functionality. These devices function by converting an electric field amplitude into a measurable frequency splitting [6] that is SI-traceable [7]. The electric field magnitude E is given by $|E|=\hbar\Delta f/P$, where $\hbar$ is Planck's constant divided by 2π, Δf is the measured frequency splitting, and P is the transition dipole moment. Current work has demonstrated sensitivities of 3 µV/sqrt(Hz) measuring electric fields as low as 7.3 µV/cm [8] and up to 40 V/m [9] in a 1-130 GHz frequency range. These results are the first calibrated field measurements in the 100 GHz – 1 THz frequency band to date. Employing this technique to image RF electric fields resulted in sub-100 µm spatial resolutions [1] for electric fields with frequencies up to 104 GHz [2, 10].

The fabrication of micrometer-sized vapor cells is one of the more challenging technological developments necessary for these sensors. The size of these vapor cells must be reduced to at least one quarter of the length of the minimum wavelength of interest in order to prevent variations in the measured RF fields produced by standing waves. These cells must be all dielectric, made of quartz or Pyrex for example, and must be filled with alkali atoms such as Rb and Cs or a mixture of atomic species. The fabrication of micrometer-sized vapor cells suffers from atomic adsorption to the cell walls. These vapor cells must employ a mitigation technique for the reduced vapor pressure such as novel coatings or materials, bonded infrared absorption glass to the outside of the cell for IR heating or optical coupling mirrors bonded to the cell to form optical resonators for enhanced atom-light interaction.

Such vapor cell production would not only benefit electric field sensing but atomic vapor-based magnetometry. Atomic vapor magnetometry currently provides the most sensitive magnetic field measurements [11] but it does not have high spatial resolution because it is limited to integration over the vapor cell length. Commercially available micrometer-sized atomic vapor cells would allow for the extension of atom-based magnetometry into a different spatial resolution regime [12, 13].

PHASE I: Demonstrate the operation of key components towards the electric field or power sensor in a laboratory setting such as: broadband measurements (100-250 GHz), electric field sensitivities better than 100 µV/cm, circuitry imaging with better than 50 µm spatial resolution, or fabrication of an alkali vapor cell with sub-mm length scales, and the development of a technique to mitigate reduced vapor pressures. Phase I deliverables include a final report that documents the results of each demonstration and design concepts to extend the measurement space to 1 GHz - 1 THz, improve the spatial resolution, and detail an experimental method to use the device in a high electric field environment (greater than 1 kV/m).

PHASE II: Construct and demonstrate a breadboard system with a path towards a portable device. If the performer is developing components, fabricate the miniaturized alkali vapor cell to less than a 100 µm length. Phase II deliverables:

1. Demonstration in a simulated or relevant environment achieving broadband measurement (1 GHz – 1 THz), detection of less than 1 µV/cm electric fields, and sub-wavelength imaging with better than 10 µm spatial resolution.
2. Final report that documents the results of the demonstration and specifications of the fabricated alkali vapor cell
3. Completed designs for a portable prototype. This phase is expected to reach TRL 5.

DP2: Offerors interested in submitting a DP2 proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of this 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. Read and follow section 7.0 of the DARPA 15.2 DP2 solicitation instructions. 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 proposalDP2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE III: If successful this technology could transition to multiple DoD offices and could eventually replace current 1 GHz – 1 THz based electric field and power sensors, removing the need for recalibration against standards. This device could also be commercially viable to examine densely packed microwave circuit designs imaging the electric fields with sub-100 µm resolution to strongly inform and guide circuit design. Development of the micrometer-sized alkali-based vapor cells would be commercially usable for atomic vapor-based magnetometry opening new realms of spatial resolution for the highest magnetic field sensitive magnetometers. Such vapor cells could also have potential use in the timing community.

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KEYWORDS: atomic sensor, Rydberg, EIT, vapor cell, self-calibrated, RF, microwave, millimeter-wave, directed energy

SB152-004 TITLE: Many-Core Acceleration of Common Graph Programming Frameworks

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 15.2 DoD Program Solicitation and the DARPA 15.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREAS: Information Systems, Electronics

OBJECTIVE: Develop next-generation many-core acceleration capabilities for current leading edge graph programming ecosystems such as Tinkerpop, GraphLab, and GraphX, deployable on modern massively parallel architectures such as GPU-accelerated systems, to facilitate ease of integration and lower barriers to adoption of many-core technologies.

DESCRIPTION: Today there is a DoD need for graph analytics capabilities, which are critical for a large range of application domains with a vital impact on both national security and the national economy, including, among others: counter-terrorism; fraud detection; drug discovery; cyber-security; social media; logistics and supply chains; e-commerce, etc. Widely used graph development frameworks have enabled online (but not real-time) graph analytics for broad classes of problems at a modest data scales and support only offline analytics for very large data scales. The Facebook graph today has over 1 Trillion edges. A single iteration of a graph traversal takes up to 3 minutes using Apache Giraph on 200 commodity CPU servers. A full breadth first traversal of the graph could take nearly 20 minutes, and algorithms that relax to a solution can require 50-100 iterations, implying that it could take several hours to compute the Page Rank of the Facebook graph.

Bringing analytics within these graph programming frameworks into real-time on large graphs requires that they be able to leverage the computing advances in multi-core platforms. However, scalable, data-parallel graph analytics on many-core hardware is a fundamentally hard problem that goes well beyond the current state of the art. Graph data models and algorithms are used for network structured data, when the data are poorly structured, or when complex relationships must be drawn from multiple data sets and analyzed together. Graph operations are inherently non-local and, for many real-world data sets, that non-locality is aggravated by extreme data skew.

Graph analytics are data intensive rather than compute intensive which means that memory and network bandwidth are the bottlenecks for graph processing. Overall, current solutions applied to scaling graph frameworks such as Tinkerpop and Graphlab do not have all of the desired attributes integrated, specifically 1) Solutions based on map/reduce or requiring checkpoints to disk are 1000s of times too slow to extract the value latent in graphs for time-sensitive analytics. (2) Solutions based on non-updatable data representations are limited in their application to complex analytics. 3) Solutions that provide robust scaling and high performance require specialized programming techniques that are not easily accessible to the existing graph development community. Approaches leveraging multi-core technology have significant promise. At the purely hardware level, GPU memory bandwidth is set to jump by 4x by Q1 2016 (Pascal). This should provide a 4x speedup. Thus going from 10x - 100x speedups over CPUs to 40x - 400x over CPUs.

PHASE I: Develop innovative approaches to apply many-core GPU and/or hybrid CPU technologies to existing graph development APIs. The focus should be on framework fidelity, computational scalability, and easing the burden of integration. In addition, develop detailed analysis of predicted performance of the proposed approach and plans for developing the approach into a comprehensive platform to accelerate a graph framework in Phase II. The Phase I deliverable is a final report documenting the effort and results.

PHASE II: Develop a comprehensive implementation of an existing graph framework accelerated for commodity high performance many-core (GPUs) and multi-core CPUs technologies using the approaches identified in Phase I. Develop a prototype and establish a preliminary benchmark using various standard problems, and apply the tool to a DoD relevant problem. Phase II deliverables will include software, a final report documenting the effort, a document describing the architecture and a user's manual.

DP2: Offerors interested in submitting a DP2 proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of this 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. Read and follow section 7.0 of the DARPA 15.2 DP2 solicitation instructions. 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 proposalDP2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE III: Real time data ingest and reasoning analytics for military situational awareness platforms. Commercial uses of the accelerated graph framework include a 1000-10000X acceleration of existing graph analytics such as Facebook's current graph traversal.

REFERENCES:

1. http://www.mapgraph.io/ (Sourcecode – Apache 2 license) http://sourceforge.net/projects/mpgraph/files/

2. http://www.stingergraph.com (Sourcecode – BSD derivative license) https://github.com/robmccoll/stinger

KEYWORDS: PlanX, XDATA, Cyber operations, Cyber, situational awareness

SB152-006 TITLE: Compact, Configurable, Real-Time Infrared Hyperspectral Imaging System

PROPOSALS ACCEPTED: Phase I and DP2. Please see the 15.2 DoD Program Solicitation and the DARPA 15.2 Phase I Instructions for Phase I requirements and proposal instructions.

TECHNOLOGY AREAS: Sensors, Chemical/Biological Defense

OBJECTIVE: Develop and demonstrate a re-configurable, real-time portable infrared hyperspectral imaging system. This capability should have the ultimate utility in detection and identification of critical targets in complex, highly variable backgrounds.

DESCRIPTION: There is a compelling DoD need to create a low cost, compact and reconfigurable infrared imaging spectrometer that can operate in real time, and in a variety of backgrounds and ambient conditions. Hyperspectral imaging (HSI) systems have been fielded for the detection of hazardous chemical and explosives threat materials, tag detection, friend vs. foe detection (IFF) and other defense critical sensing missions. Such systems currently exist in airborne and ground sensing configurations in short-wave, mid-wave and long-wave infrared (IR) spectral regions. They are based on HSI sensor hardware architectures combined with multivariate analysis algorithms [1,2]. While these imaging systems can provide sensitive and specific detections of targets and identification of materials in complex backgrounds, they are typically large, costly to field, operate, and support, and generally do not operate in real-time. Those systems that operate in real time typically compromise some degree of freedom, such as the number of spectral bands, image definition, or number of targets being detected. Reconfiguring the system to an alternative set of targets or backgrounds requires significant effort, which makes adjusting to dynamic mission conditions impractical. Nonetheless, intelligence based on HSI systems has proven very useful, resulting in an increasing demand for it; but due to the high cost of procuring and maintaining an HSI system, they are only available to privileged users.

Specifically, what is needed is an IR hyperspectral imaging and sensing capability with the following characteristics: (1) rapidly field-configurable operation to adapt to different targets or operating conditions; (2) real-time, target on-the-move operation, ideally at the frame rate of the focal plane array camera; (3) real-time automated target signature detection, performed within the system to dramatically reduce data bandwidth, downlink transmission bandwidth requirements, and post-processing; (4) significantly reduced cost, size, and weight; and (5) imaging operation with minimal support infrastructure. The resulting system should be able to support one or more of the following missions: counter IED detection, IFF, bio/chemical WMD detection and tag, track and locate (TTL) missions. The performance goals of such a system are:

- Frame rate 10 frame per second (fps) or greater

- Free spectral range covering at least one band of 850-1700 nm for SWIR, 3-5µm for MWIR, 8-11+µm for LWIR
- Form factor, suitable for operation as a handheld, wearable or UAV-mounted configuration
- Weight less than 5 lbs.
- Run time greater than 4 hours, with power source included in weight metric
- Cost of less than $50,000 in volume of 1000 or more
- High Definition Chemical Image - Megapixel (1Kx1K) or greater
- Low latency of less than or equal to 100ms
- Interface compatible with XML schema
- Autonomously link to existing military architecture or infrastructure (e.g., cell phone)

In summary, a Compact, Mission-Configurable, on-Demand, Real-Time, Infrared Hyperspectral Imaging Sensor is envisioned. It is acknowledged that all spectral ranges may not be accommodated in a single sensor, and that the objective vision may not be fully realizable during the course of a Phase II SBIR. However, concrete and compelling hardware/software progress towards this vision is expected to be demonstrated.

PHASE I: Design a concept for an infrared hyperspectral imaging system capable of real-time, and multi-mission configurable-on-demand operation with specific performance objectives as described. Develop an analysis of predicted performance, and define key component technological milestones. Establish performance goals in terms of parameters such as time of operation; probability of detection and false alarm; detection time; spectral range; image quality; field of view; day, night and obscured condition visualization; image frame rate; and size, weight and power (SWaP). In addition, provide a contrast with existing hyperspectral imaging systems. Produce an initial mockup, possibly using 3D printed parts and/or solid models, showing the system form factor at the preliminary design level. Phase I deliverables would include:

- A description of the system design and functions mapped to real-time imaging system requirements,
- A performance assessment against existing approaches,
- An evaluation of key tradeoffs, and
- A risk reduction and demonstration plan.
- Final report/phase II proposal

PHASE II: Develop and demonstrate a prototype real-time mission-configurable infrared hyperspectral imaging sensor system with the specified features, including on board detection, and operation at 10 fps or higher sampling rate. Construct and demonstrate the operation of a laboratory prototype, which would have the core features needed to achieve mission configurability capabilities. Exercise relevant software functions and exposure to different mission conditions, including demonstration of ability to change system detection configurations against multiple different target sets through rapid field configuration. Perform additional analyses as needed to project eventual performance capabilities. Phase II deliverables would include:

- A final design with all drawings, simulations and modeling results;
- One prototype of the real-time chemical imaging system;
- Software applications as needed;
- Performance data compared with performance and environmental goals; and
- Schedule with financial data for program execution.
- Preliminary and critical design reviews
- Monthly reports

DP2: Offerors interested in submitting a DP2 proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of this 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. Read and follow section 7.0 of the DARPA 15.2 DP2 solicitation instructions. 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 proposalDP2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE III: As described above, the military utility of the data and intelligence that is generated by the current large and costly systems has been demonstrated. Driving the SWaP and cost down such that the system can be used by a dismount or on a small UAV will enable proliferation of the capability in the same way that night vision goggles or cell phones have become an integral part of the soldier's arsenal. Requiring the system to be compatible with existing systems and data formats will help ensure more rapid acceptance and use. Commercial application of hyperspectral imaging has been increasing in parallel to military applications. These include agriculture, mining, medical imaging and diagnoses, environmental management, disaster management and hazard assessment. Like military applications, the cost and size of these systems limits their availability to all but the most privileged users. Driving the system cost and SWaP down would enable proliferation of these devices to a potentially large user base, including municipalities (police, fire, etc.), agriculture (farmers, land managers, etc.), and healthcare (health screening and microbiology).

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KEYWORDS: Hyperspectral; infrared; real-time; spectrometer; handheld; counter IED; unmanned aerial vehicle; UAV

SB152-007 TITLE: Depth Insensitive Pressure/Vector Sensor Arrays

TECHNOLOGY AREAS: Sensors

PROPOSALS ACCEPTED: DP2 Only.

OBJECTIVE: Develop passive, low-power arrays of acoustic pressure and vector sensors that can operate effectively across all ocean depths to detect, classify and localize low-level signals. The focus is on optical sensor technology, low-power array sensor optical telemetry and interrogator/demodulator.

DESCRIPTION: There is a critical DoD need for reliable acoustic vector sensor arrays that provide high signal dynamic range and measurement sensitivity, mitigate the self-noise problems, and are capable of a being operated in both deep and shallow oceans environments. This topic seeks innovative solutions for arrays of acoustic pressure and vector sensors. "Fiber optic" array technology is maturing rapidly, but has suffered from poor mechanical reliability, relatively high power consumption not suitable for long-life battery operated systems and high sensor self-noise. Optical acoustic pressure and vector sensors are a primary technology that may provide improved array performance in a relatively compact design. A design approach based on optical sensor interrogation and telemetry is preferred due to the intrinsic cost, size, weight, and power advantages of this technology.

All required components of the array should be addressed (sensor, interconnect, interrogation system, processing, power). The acoustic band of interest is 15,000 Hertz and below, and the primary interest is in acoustic frequencies of 1000 Hz and below. An important objective is to develop a low cost, size, weight and power (CSWAP) interrogation/telemetry capability for the sensor array design, so that the total self-noise is significantly below ambient noise. In the deep ocean, ambient acoustic noise can be much lower at depth, therefore the acoustic performance threshold for self-noise from optical sensors and electronic sensor components to be 20 dB//re 1 µPa2/Hz below Sea State 0 and low shipping noise levels, with an objective of 30 dB//re 1 µPa2/Hz below Sea State 0.

The sensors and array designs should be capable of operating with full functionality and performance in a wide range of scenarios and ocean environments, especially in deep (> 6 kilometer depths) deployments. The array may incorporate as many as 100 sensor elements, and must be capable of long-life storage and operation on battery power without maintenance for at least one year. Additionally, consideration could be given to miniaturizing the sensor elements (very low CSWAP) for implementation in A-sized sonobuoys (36 inch length, 4 7/8 inch diameter, and less than 39 pounds) with shorter operational life expectations. The integration of appropriate modeling and simulation with data analysis in the development and testing of the technology solution will help to ensure the robust performance of the array in a variety of ocean environments and deployment scenarios.

PHASE I: Develop an innovative concept for advanced, small, low power acoustic vector sensor arrays (sensors, interconnect, interrogation system, processing, power) and a path to a low CSWAP implementation that meets the performance requirements outlined above. Demonstrate the feasibility of the concept by analysis, simulation and demonstration of constituent technologies. Phase I should establish that the technology is depth insensitive, has the desired self-noise performance and meets system deployment requirements. Embedded computational requirements must be addressed during Phase I and demonstrated (by analysis) to be implementable in a real time, power constrained system. Required Phase I deliverables will include: 1) a Phase I final report that documents the design concepts considered and trade-off analysis, selected design and implementation, feasibility analysis of the constituent critical technologies, and feasibility analysis of the embedded computational requirements considering size, weight and power constraints; and 2) a Phase II development plan that must address critical technical risk reduction efforts and provides performance goals and key technical milestones for continued development.

PHASE II: Based on the results of Phase I program and the Phase II development plan, the performer will develop a prototype array (sensors, interconnect, sensor interrogation system, processing, power) for demonstration and performance validation in the lab and underwater. The prototype will be evaluated to determine its technical performance against the goals defined in the Phase I and the feasibility, manufacturability and reliability as defined in the Phase II development plan.

Prototype performance should be demonstrated via modeling and simulation and in-situ testing. Demonstration results should be used to refine the prototype into a preproduction design that will meet all requirements. The use of open architectures and standards is encouraged. Phase II deliverables will include: 1) a final report that documents the final pre-production prototype design; 2) in-water demonstration of prototype sensor performance; 3) sensor and system performance analysis 3) Prototype array senor array and associated array sensor interrogation system hardware; and 4) a Phase III plan to address commercialization and transition to the Department of Defense (DoD) for operational use.

DP2: Offerors interested in submitting a DP2 proposal in response to this topic must provide documentation to substantiate that the scientific and technical merit and feasibility described in the Phase I section of this 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. Read and follow section 7.0 of the DARPA 15.2 DP2 solicitation instructions. 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 proposalDP2 proposal where it determines that the offeror has failed to demonstrate the scientific and technical merit and feasibility of the Phase I project.

PHASE III: The performer will build, unit-test, integrate and field-test sensor arrays into developmental or deployed DoD systems. Infield testing and performance validation in operationally significant environments will be used to demonstrate the technology readiness level assessment and suitability of the sensor system design for technology transfer into current and future DoD systems. Commercial applications include ship monitoring in ports and waterways, oil platform surveillance and protection, long-duration at- sea oceanographic surveys, marine mammal and fish monitoring, and long-term standoff seismic monitoring.

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KEYWORDS: array; sensor; passive sensing; multimodal sensing; detection, classification, localization and tracking (DCLT); in-node sensor processing