AMENDMENT 1
The purpose of Amendment 1 to DARPA Release 1 is to update Phase I feasibility language in Appendix A – White Paper section (e)(1), pg. 25 (updated text highlighted)

Defense Advanced Research Projects Agency (DARPA)
DoD 23.4 Small Business Innovation Research (SBIR) Annual BAA
Proposal Submission Instructions Release 1

INTRODUCTION

DARPA's mission is to make strategic, early investments in science and technology that will have long-term positive impacts on our national security. As part of this mission, DARPA makes high-risk, high-reward investments in science and technology that have the potential to disrupt current understandings and/or approaches. The pace of discovery in both science and technology is accelerating worldwide, resulting in new fields of study and the identification of scientific areas ripe for small business utilization through the SBIR and STTR programs. Small businesses are critical for developing technology to support national security. Proposers are encouraged to consider whether the R/R&D being proposed to DoD Components also has private sector potential, either for the proposed application or as a base for other applications. The topics below focus on technical domains important to DARPA's mission pursuing innovative research concepts that fall within one of its technology offices. More information about DARPA's technical domains and research topics of interest may be found at: http://www.darpa.mil/about-us/offices.

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

Specific questions pertaining to the administration of the DARPA Program and these proposal preparation instructions should be directed to: DARPA Small Business Programs Office at SBIR_BAA@darpa.mil. DSIP Topic Q&A will NOT be available for these DARPA topics. Technical questions related to improving the understanding of a topic's requirements must be submitted to SBIR_BAA@darpa.mil by the deadline listed below.

The following dates apply to this DARPA Topic release:

January 18, 2023: Topics issued for pre-release
February 02, 2023: Topics open; DARPA begins accepting proposals via DSIP
February 28, 2023: Deadline for technical question submission
March 07, 2023: Deadline for receipt of proposals no later than **12:00 pm ET**

DIRECT TO PHASE II PROPOSAL GUIDELINES
Proposers should refer to the DARPA Direct to Phase II Proposal Instructions, provided in Appendix A.

Current Release Award Structure by Topic

Standard Format

Topic Number	Direct to Phase II

	Tech Volume*	Award Amount	Period of Performance (PoP)	Option Amount	Option PoP
HR0011SB20234-02	35 pages	$1,200,000	24 months	$600,000	12 months

Technical Volume (Volume 2) – Abbreviated Standard Format (35-page)
If a proposer can provide adequate 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, the Direct to Phase II (DP2) authority allows the Department of Defense (DoD) to make an award to a small business concern under Phase II of the SBIR program without regard to whether the small business concern was provided an award under Phase I of an SBIR program. This topic is accepting DP2 proposal submissions.

DP2 Feasibility Documentation shall not exceed 10 pages. DP2 Technical Proposal shall not exceed 20 pages. Phase II commercialization strategy shall not exceed 5 pages. This should be the last section of the Technical Volume and will not count against the 30-page limit.

White Paper & Slide Deck Proposal

Topic Number	Direct to Phase II					
	Technical Volume		Award Amount	Period of Performance (PoP)	Option Amount	Option Period
	White Paper	Slide Deck				
HR0011SB20234-01	20 pages	15 pages	$750,000	9 months	$750,000	12 months
HR0011SB20234-03	20 pages	15 pages	$1,000,000	12 months	$800,000	12 months

Note: Please see Appendix A, section III (d) for complete instructions on the White Paper/Slide Deck technical volume format.

Technical Volume (Volume 2) – White Paper & Slide Deck Format
If a proposer can provide adequate 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, the Direct to Phase II (DP2) authority allows the Department of Defense (DoD) to make an award to a small business concern under Phase II of the SBIR program without regard to whether the small business concern was provided an award under Phase I of an SBIR program. This topic is accepting DP2 proposal submissions.

The white paper shall not exceed 20 pages, and the slide deck shall not exceed 15 pages. For information on the content of these elements of the technical proposal and the commercialization strategy, please see Attachment B: DARPA Direct to Phase II (DP2) Instructions.

Content of the Technical Volume
Proposers should refer to the DARPA DP2 Proposal Instructions, provided in Appendix A and on the DARPA Small Business site (https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program).

Cost Volume (Volume 3)
Please see the chart above for award amounts listed by topic. Proposers are required to use the Direct to Phase II – Volume 3: Cost Proposal Template (Excel Spreadsheet) provided on the

DARPA Small Business site (https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program). Subcontractors may also submit unsanitized costs using this template directly to DARPA at SBIR-BAA@darpa.mil.

Please review the updated Percentage of Work (POW) calculation details included in the DoD Program BAA. DARPA will occasionally accept deviations from the POW requirements with a letter of explanation or approval from the Funding Agreement officer.

Company Commercialization Report (CCR) (Volume 4)
Completion of the CCR as Volume 4 of the proposal submission in DSIP is required. Please refer to the DoD SBIR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DARPA during proposal evaluations.

Supporting Documents (Volume 5)
In addition to the documents required by DoD, small businesses may also submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3) in Volume 5.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)
DARPA does not offer TABA funding.

EVALUATION AND SELECTION
All proposals will be evaluated in accordance with the evaluation criteria listed in the DoD SBIR 2023.4 BAA. DARPA will conduct an evaluation of each conforming proposal. Proposals that do not comply with the requirements detailed in this BAA and the research objective(s) of the corresponding topic are considered non-conforming and therefore are not evaluated nor considered for award.

Using the evaluation criteria, the Government will evaluate each proposal in its entirety, documenting the strengths and weaknesses relative to each evaluation criterion, and, based on these identified strengths and weaknesses, determine the proposal's overall selectability. Proposals will not be evaluated against each other during the evaluation process, but rather evaluated on their own individual merit to determine how well the proposal meets the criteria stated in this BAA and the corresponding DARPA topic.

Awards will be made to proposers whose proposals are determined to be the most advantageous to the Government, consistent with instructions and evaluation criteria specified in the DoD SBIR 2023.4 BAA and availability of funding. Given the limited funding available for each topic released, not all proposals considered selectable will be selected for funding.

For the purposes of this proposal evaluation process, a selectable proposal is defined as follows:

Selectable: A selectable proposal is a proposal that has been evaluated by the Government against the evaluation criteria listed in the DoD SBIR 2023.4 BAA and DARPA topic, and the strengths of the overall proposal outweighs its weaknesses. Additionally, there are no accumulated weaknesses that would require extensive negotiations and/or a resubmitted proposal.

For the purposes of this proposal evaluation process, a non-selectable proposal is defined as follows:

Non-Selectable: A proposal is considered non-selectable when the proposal has been evaluated by the Government against the evaluation criteria listed in the DoD SBIR 2023.4 BAA and DARPA topic, and the strengths of the overall proposal do not outweigh its weaknesses.

Proposing firms will be notified of selection or non-selection status for a Phase I award within 90 days of the closing date of the DoD SBIR 2023.4 BAA. It is the policy of DARPA to treat all proposals as source selection information and to disclose their contents only for the purpose of evaluation. Restrictive notices notwithstanding, during the evaluation process, submissions may be handled by support contractors for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors are expressly prohibited from performing DARPA-sponsored technical research and are bound by appropriate nondisclosure agreements. Input on technical aspects of the proposals may be solicited by DARPA from other Government and/or non-Government consultants/experts who are strictly bound by the appropriate non-disclosure requirements. No submissions will be returned. Upon completion of the evaluation and selection process, an electronic copy of each proposal received will be retained at DARPA.

Proposal titles, abstracts, anticipated benefits, and keywords of proposals that are selected for contract award will undergo a DARPA Policy and Security Review. Proposal titles, abstracts, anticipated benefits, and keywords are subject to revision and/or redaction by DARPA. Final approved versions of proposal titles, abstracts, anticipated benefits, and keywords may appear on the DoD SBIR/STTR awards website and/or the SBA's SBIR/STTR award website (https://www.sbir.gov/sbirsearch/award/all).

Refer to the DoD SBIR 2023.4 Program BAA for procedures to protest the Announcement.
As further prescribed in FAR 33.106(b), FAR 52.233-3, Protests regarding the 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

AWARD AND CONTRACT INFORMATION

1. **General Award Information**

Multiple awards are anticipated. DARPA may award FAR-based government contracts (Firm- Fixed Price or Cost-Plus Reimbursement) or Other Transactions for Prototypes agreement (under the authority of 10 U.S.C. § 4022) subject to approval of the Contracting Officer. The amount of resources made available for each topic issued under this BAA will depend on the quality of the proposals received and the availability of funds.

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

For proposers that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:
>   a. Prior to submitting a proposal, firms must register with the SBA Company Registry Database.
>   b. The proposer within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program, under SBIR/STTR BAA Forms. Include the SBIR VC Certification in the Supporting Documents (Volume 5).
>   c. Should a proposer become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposer must immediately notify the Contracting

Officer, register in the appropriate SBA database, and submit the required certification which can be found under SBIR/STTR BAA Forms and Templates on https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program.

The Government reserves the right to select for negotiation all, some, one, or none of the proposals received in response to this announcement and to make awards with or without communications with proposers. Additionally, the Government reserves the right to award all, some, one, or none of the options on the contract(s)/agreement(s) of the performers based on available funding and technical performance. If warranted, portions of resulting awards may be segregated into pre-priced options. Additionally, DARPA reserves the right to accept proposals in their entirety or to select only portions of proposals for award. In the event that DARPA desires to award only portions of a proposal, negotiations may be opened with that proposer. The Government reserves the right to fund proposals in phases with options for continued work, as applicable.

The Government reserves the right to request any additional, necessary documentation once it makes the award instrument determination. The Government reserves the right to remove a proposal from award consideration should the parties fail to reach agreement on award terms, conditions, and price within a reasonable time, and/or the proposer fails to provide requested additional information within three business days.

In all cases, the Government Contracting Officer reserves the right to select award instrument type, regardless of instrument type proposed, and to negotiate all instrument terms and conditions with selectees. DARPA will apply publication or other restrictions, as necessary, if it determines that the research resulting from the proposed effort will present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Any award resulting from such a determination will include a requirement for DARPA permission before publishing any information or results on the program. For more information on publication restrictions, see the DoD SBIR 2023.4 BAA.

Because of the desire to streamline the award negotiation and program execution process, proposals identified for negotiation will result in negotiating a type of instrument for award that is in the best interest of the Government. In the case of an OT for Prototype agreement under DARPA's authority to award OTs for prototype projects, 10 U.S.C. § 4022, use of an OT provides significant opportunities for flexible execution to assist in meeting DARPA's aggressive SBIR/STTR program goals.

All proposers that wish to consider an OT award should carefully read the following:

The flexibility of the OT award instrument is beneficial to the program because the Performer will be able to apply its best practices as required to carry out the research project that may be outside of the Federal Acquisition Regulation (FAR) process-driven requirements. Streamlined practices will be used, such as milestone-driven performance, intended to reduce time and effort on award administration tasks and permit performers to focus on the research effort and rapid prototyping. Because of this ability, OTs provide the Agreements Officer the flexibility to create an award instrument that contains terms and conditions that promote commercial transition, reduce some administratively burdensome acquisition regulations, and meet SBIR/STTR program goals.

Proposers must only propose an OT agreement with fixed payable milestones. Fixed payable milestones are fixed payments based on successful completion of the milestone accomplishments agreed to in the milestone plan. Refer to the Other Transactions for Prototypes Fact Sheet and Other Transaction for Prototype Agreement, available at https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program. Specific milestones will be based upon the research objectives detailed in the topic.

Please see https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program for more information on OTs.

2. Transition and Commercialization Support Program (TCSP)

DARPA will provide services to Phase II or DP2 awardees upon contract execution through the Transition and Commercialization Support Program (TCSP) at no cost to awardees. The TCSP goal is to maximize the potential for SBIR/STTR companies to move their technology beyond Phase II and into other research and development programs for further maturity or into solutions or products for DoD acquisition programs, other Federal programs, and/or the commercial market. Please visit https://www.darpa.mil/work-with-us/for-small-businesses/commercialization-continued for more information on DARPA TCSP.

3. Embedded Entrepreneurship Initiative

Awardees of SBIR funding pursuant to this BAA may be eligible to participate in the DARPA Embedded Entrepreneurship Initiative (EEI) during the Period of Performance. Invitation to participate in EEI is at the sole discretion of the Government based on evaluation of technical and commercial factors and subject to program balance and the availability of funding. EEI is a limited scope program offered by DARPA, at DARPA's discretion, to a small subset of awardees. The goal of DARPA's EEI is to increase the likelihood that DARPA-funded technologies take root in the U.S. and provide new capabilities for national defense. EEI supports DARPA's mission "to make pivotal investments in breakthrough technologies and capabilities for national security" by accelerating the transition of innovations out of the lab and into new capabilities for the Department of Defense (DoD). EEI investment supports development of a robust and deliberate Go-to-Market strategy for selling technology product to the government and commercial markets and positions DARPA awardees to attract U.S. investment. The following is for informational and planning purposes only and does not constitute solicitation of proposals to the EEI.

There are three elements to DARPA's EEI: (1) A Senior Commercialization Advisor (SCA) from DARPA who works with the Program Manager (PM) to examine the business case for the awardee's technology and uses commercial methodologies to identify steps toward achieving a successful transition of technology to the government and commercial markets; (2) Connections to potential industry and investor partners via EEI's Investor Working Groups; and (3) Additional funding on an awardee's contract for the awardee to hire an embedded entrepreneur to achieve specific milestones in a Go-to-Market strategy for transitioning the technology to products that serve both defense and commercial markets. This embedded entrepreneur's qualifications should include business experience within the target industries of interest, experience in commercializing early stage technology, and the ability to communicate and interact with technical and non-technical stakeholders. Funding for EEI is typically no more than $250,000 per awardee over the duration of the award. An awardee may apportion EEI funding to hire more than one embedded entrepreneur, if achieving the milestones requires different expertise that can be obtained without exceeding the awardee's total EEI funding. The EEI effort is intended to be conducted concurrent with the research program without extending the period of performance.

EEI Application Process:
After receiving an award under the solicitation, awardees interested in being considered for EEI should notify their DARPA Program Manager (PM) during the period of performance. Timing of such notification should ideally allow sufficient time for DARPA and the awardee to review the awardee's initial transition plan, identify milestones to achieve under EEI, modify the award, and conduct the work required to achieve such milestones within the original award period of performance. These steps may take 9-18 months to complete, depending on the technology. If the DARPA PM determines that EEI could be of benefit to transition the technology to product(s) the Government needs, the PM will refer the performer to DARPA Commercial Strategy.

DARPA Commercial Strategy will then contact the performer, assess fitness for EEI, and in consultation with the DARPA technical office, determine whether to invite the performer to participate in the EEI. Factors that are considered in determining fitness for EEI include DoD/Government need for the technology; competitive approaches to enable a similar capability or product; risks and impact of the Government's being unable to access the technology from a sustainable source; Government and commercial markets for the technology; cost and affordability; manufacturability and scalability; supply chain requirements and barriers; regulatory requirements and timelines; Intellectual Property and Government Use Rights, and available funding.

Invitation to participate in EEI is at the sole discretion of DARPA and subject to program balance and the availability of funding. EEI participants' awards may be subsequently modified bilaterally to amend the Statement of Work to add negotiated EEI tasks, provide funding, and specify a milestone schedule which will include measurable steps necessary to build, refine, and execute a Go-to-Market technology transition plan aimed at delivering new capabilities for national defense. Milestone examples are available at: https://www.darpa.mil/work-with-us/contract-management.

Awardees under this solicitation are eligible to be considered for participation in EEI, but selection for award under this solicitation does not imply or guarantee participation in EEI.

For more information please refer to the EEI website https://eei.darpa.mil/.

4. DARPA Toolbox Initiative

DARPA Toolbox is an Agency-wide effort to provide open licensing opportunities with commercial technology vendors to the researchers behind DARPA programs. DARPA Toolbox provides easy, low-cost, scalable access to state-of-the-art tools and intellectual property (IP) under predictable legal terms and streamlined acquisition procedures. The goal is to reduce performer reliance on low-quality, low-cost tools and IP that increase execution risks and complicate post-DARPA transitions.

Through this initiative, DARPA performers are granted access to select vendor tools and technologies throughout the life of their contractual relationship with the Agency. The Toolbox suppliers bring to the table proven technologies commonly used in state-of-the art commercial microelectronics or system design methodologies.

DARPA Toolbox program information and a full list of participating suppliers can be found at https://www.darpa.mil/work-with-us/darpa-toolbox-initiative. If there are tool or technologies of interest, contact the Supplier POC listed for the product, referencing the DARPA Toolbox Initiative. The Supplier POC will provide advice on products and pricing information. Include any non-production pricing quotes in your proposal. Products and pricing are between you and the suppliers – *do not* contact DARPA directly.

ADDITIONAL INFORMATION

DARPA intends to use electronic mail for all correspondence regarding these topics. Questions related to the technical aspect of the research objectives and awards specifically related to a topic should be emailed to SBIR_BAA@darpa.mil. Please reference the topic number in the subject line. All questions must be in English and must include the name, email address, and the telephone number of a point of contact.

DARPA will attempt to answer questions in a timely manner; however, questions submitted within seven (7) calendar days of the proposal due date listed herein may not be answered. DARPA will post a consolidated Frequently Asked Questions (FAQ) document. To access the posting please visit:

http://www.darpa.mil/work-with-us/opportunities. Under the topic number summary, there will be a link to the FAQ. The FAQ will be updated on an ongoing basis until one week prior to the proposal due date.

Technical support for the Defense SBIR/STTR Innovation Portal (DSIP) is available Monday through Friday, 9:00 a.m. – 5:00 p.m. ET. Requests for technical support must be emailed to DoDSBIRSupport@reisystems.com with a copy to SBIR_BAA@darpa.mil.

DARPA SBIR 23.4 Topic Index
Release 1

HR0011SB20234-01   Vibe: Innovation in Commodity Coherence

HR0011SB20234-02   Synthetic User Personas (SUP)

HR0011SB20234-03   Space Metamaterial Electronically Scanned Array (Space-MESA)

HR0011SB20234-01   TITLE: Vibe: Innovation in Commodity Coherence

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

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Beamforming is utilized in numerous applications from wireless communications, acoustics, radar, and sonar as a means to direct a specific signal towards a particular receiver. Such applications typically require computing power to perform the signal processing and a sensor array to send or receive signals. These requirements are tailored to the specific application and may cause significant impact to the overall resources available for operations. Given the ubiquity of Commercial Off-the-Shelf (COTS) compute, sensors, and sensor platforms, there are multiple applications that could benefit from utilizing commodity hardware in lieu of requiring application-specific technologies. Beamforming requires relative time synchronization between nodes within an array and the ability to establish range metrics between senders prior to being able to beamform to a specific receiver. Typically, arrays are custom built where such information is already known or can easily be calculated. However, the creation of an array from heterogeneous commodity hardware requires such calculations to be performed on-the-fly and repeatedly as there could be modifications to the array during signal emissions. This Defense Advanced Research Projects Agency (DARPA) topic is seeking technologies for achieving time synchronization and coherence from a cooperating set of commodity devices. Vibe performers will explore novel approaches and develop prototypes for establishing distributed frequency coherence between a set of commodity devices to be able to achieve beamforming to a known receiver. Vibe is interested in any hardware/software methods that can achieve beamforming while also minimizing customized hardware solutions, maintaining a small form factor, and leaving the hardware inconspicuous.

DESCRIPTION: Performers will develop novel approaches for utilizing commodity hardware for achieving distributed coherence and beamforming. Vibe prototypes should be able to demonstrate the ability to establish and maintain time synchronization necessary for coherent beamforming of a given frequency and waveform to a receiver. This can range from audible acoustic, ultrasonic, GSM, LTE, Bluetooth, WiFi, or other frequencies and waveforms of commercial/military interest and value. This receiver will also be controlled by the performer, but must also utilize COTS technologies to validate the transmitted signal.

PHASE I: This topic is soliciting Direct to Phase II (DP2) proposals only. Therefore, Phase I proposals will not be accepted or reviewed. Phase I feasibility will be demonstrated through evidence of: a completed feasibility study or a basic prototype system; definition and characterization of properties desirable for both Department of Defense (DoD) and civilian use; and comparisons with alternative state-of-the-art methodologies (competing approaches). This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have application to the core objective of achieving coherence between a cooperating set of commodity devices. Proposers interested in submitting a DP2 proposal must provide documentation to substantiate that the scientific and technical merit and feasibility described above have been met and describe the potential military or commercial applications. DP2 documentation should include:

- technical reports describing results and conclusions of existing work, particularly regarding the commercial opportunity or DoD insertion opportunity, and risks/mitigations, assessments;
- presentation materials and/or white papers;
- technical papers;
- test and measurement data;
- prototype designs/models;
- performance projections, goals, or results in different use cases

This collection of material will verify mastery of the required content for DP2 consideration. DP2 proposers must also demonstrate knowledge, skills, and ability in computer science, mathematics, physics, electrical engineering, and software engineering. For detailed information on DP2 requirements and eligibility, please refer to the DoD BAA and the DARPA Instructions for this topic.

PHASE II: The goal of Vibe is to design and evaluate an array to achieve coherent signal transmission and beamforming utilizing commodity hardware. Proposals should include development, installation, integration, demonstration and/or test and evaluation of the proposed prototype system. These activities should focus specifically on:
1. Evaluating the adapted solution against the proposed objectives.
2. Describing in detail how the installed solution differs from the non-defense commercial offering to solve DoD need(s) as well as how it can be scaled for wide adoption, i.e., modified for scale and broader signals.
3. Identifying the proposed solution's clear transition path considering input from affected stakeholders, including but not limited to, end users, engineering, sustainment, contracting, finance, legal, and cyber. Specifying the solution's integration with other current and potential future solutions.
4. Describing the solution's sustainability, i.e., supportability. Identifying other specific DoD or Governmental customers for the solution.

Phase II will culminate in a system demonstration using one or more compelling use case(s) consistent with commercial opportunities, DoD opportunities, and/or insertion into a DARPA program. The below schedule of milestones and deliverables is provided to establish expectations and desired results for the Phase II effort.

Schedule/Milestones/Deliverables: Proposers will execute Research and Development (R&D) plan as described in their proposal. Proposers will also complete a commercialization plan that addresses relevant material costs and potential material/equipment suppliers.
- Month 1: Phase II Kickoff briefing (with annotated slides) to the DARPA Program Manager (PM) (in person or virtual, as needed) including: any updates to the proposed plan and technical approach, risks/mitigations, schedule (inclusive of dependencies) with planned capability milestones and deliverables, proposed metrics, and plan for prototype demonstration/validation.
- Months 3, 5, 7: Technical progress reports detailing technical progress made, tasks accomplished, major risks/mitigations, a technical plan for the remainder of Phase II (while this will normally report progress against the plan detailed in the proposal or presented at the Kickoff briefing, it is understood that scientific discoveries, competition, and regulatory changes may all have impacts on the planned work and DARPA must be made aware of any revisions that result), planned activities, trip summaries, and any potential issues or problem areas that require the attention of the DARPA PM.
- Month 9: Interim technical progress briefing (live system demo with annotated slides) to the DARPA PM (in-person or virtual as needed) detailing progress made (include quantitative assessment of capability developed to date), tasks accomplished, major risks/mitigations, planned activities, and technical plan for the remainder of Phase II, the demonstration/verification plan for the end of Phase II, trip summaries, and any potential issues or problem areas that require the attention of the DARPA PM.

- Month 12, 15, 18: Quarterly technical progress reports detailing technical progress made, tasks accomplished, major risks/mitigations, a technical plan for the remainder of Phase II (with necessary updates as in the parenthetical remark for Months 3, 5, and 7), planned activities, trip summaries, and any potential issues or problem areas that require the attention of the DARPA PM.
- Month 21/Final Phase II Deliverables: Final architecture demonstration with documented details, demonstrating the establishment of an array using commodity hardware with sufficient timing and ranging capabilities; demonstrating beamforming to a designated receiver, documented application programming interfaces; any other necessary documentation (including, at a minimum, user manuals and a detailed system design document; and the end of phase commercialization plan).

Proposers must demonstrate in their proposal the ability to apply for and obtain a Facility Clearance Letter (FCL) with secret safeguarding, or already possess an FCL with secret safeguarding by Phase III. Proposals must outline the proposer's security plan for conducting prototyping, software development and testing of DoD applications at the collateral secret level by Phase III. All proposals must be unclassified, but proposers may submit classified annexes with prior approval of the DARPA Information Innovation Office Program Security Officer (I2O PSO); for instructions on classified annex submittals, contact I2Osecurity@DARPA.mil. Security Classification Guides governing potential classified Vibe applications may be provided to authorized U.S. contractor proposers upon request.

PHASE III DUAL USE APPLICATIONS: Phase III work will be oriented towards transition and commercialization of the developed Vibe technologies. Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program.

Primary Vibe support will be to national efforts in both commercial and military applications for novel signal delivery and resilient communications. Such technology can be used for protecting transmitters, localizing specific receivers, and providing signal in non-traditional environments.

REFERENCES:
1. K. Alemdar, D. Varshey, S. Mohanti, U. Muncuk, K. Chowdhury, "RFClock: Timing, Phase and Frequency Synchronization for Distributed Wireless Networks," ACM International Conference on Mobile Computing and Networking (MobiCom 2021), New Orleans, LA, USA, 2021.
2. F. Quitin, M. M. U. Rahman, R. Mudumbai and U. Madhow, "A Scalable Architecture for Distributed Transmit Beamforming with Commodity Radios: Design and Proof of Concept," in IEEE Transactions on Wireless Communications, vol. 12, no. 3, pp. 1418-1428, March 2013, doi: 10.1109/TWC.2013.012513.121029.

KEYWORDS: coherence, ranging, distributed coordination, beamforming

TPOC-1: DARPA BAA Help Desk
Email: SBIR_BAA@darpa.mil

HR0011SB20234-02   TITLE: Synthetic User Personas (SUP)

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

OBJECTIVE: The objective of Synthetic User Personas (SUP) is to generate labeled, synthetic cyber data suitable for enabling machine learning algorithms that support holistic cyber defenses.

DESCRIPTION: Currently there is little to no labeled unified host and network data available to the cyber research community to facilitate the development and testing of machine learning algorithms for cyber defenses. Both network data, that captures network connections and packet flows, and host or endpoint data, that captures the use of applications and other activities on a machine, are necessary to build comprehensive cyber defenses.

There are two categories of existing datasets. The first is anonymized data from networks with human users such as that provided by the Los Alamos National Laboratory [1]. The second is synthetic data generated and collected from a cyber exercise [2]. The data generated using each approach has significant problems that prevent its use in developing and testing machine learning algorithms.

One strength of anonymized data is that none of the events are synthetic. The data represents the actual activity on the network from which it was collected. What anonymized data typically lacks, however, is any sense of ground truth. Anonymized data usually contains limited events, preventing more realistic enrichments and limiting the scope of detection algorithms that can be trained. Using anonymized data from a real network also raises the question of whether there was a malicious actor active when collecting the data, and as a result, there is malicious activity represented in the dataset. If there was a malicious actor, there is no reliable or practical way to identify the specific events that were produced by the actor's activity. As a result, such datasets are not suitable for training machine learning algorithms. Further, elements of anonymized datasets may not be consistent amongst each other since there may be correlations in the actual collected data that are not recognized and preserved by the anonymization process.

Alternatively, synthetic data can be easily and automatically annotated with ground truth (e.g., accurately identify and label benign and malicious events). However, to date, synthetic datasets lack the realism required to fully support development, training, and testing of machine learning algorithms. Synthetic datasets also typically contain unwanted artifacts that reduce or eliminate their value (e.g., artificial artifacts introduce biases when training machine learning algorithms).

The existence of unified endpoint and network data is rare because of several issues. First, the anonymization of endpoint data and network data both present unique challenges. Notably, the limitless variations of potential endpoint data makes anonymizing it impossible for arbitrary use cases. Preserving correlations among data elements in both types of data is also incredibly challenging, and again impossible for generalized cases. Second, the collection of endpoint data for research purposes typically requires Institutional Review Board approval. Third, the configuration management of and policies governing the endpoints may prohibit the deployment of a collection agent. Finally, most commercial agents do not make collected endpoint telemetry available for local analysis, instead sending it for centralized (e.g., cloud) processing.

SUP will implement synthetic agents designed to generate user activity without creating spurious network or host artifacts. SUP will not create a self-hosted agent that generates activity and filters out its own events from the event stream. Rather, SUP will passively and remotely interpret data (e.g., from a computer screen) to understand the machine state, and then interact with the machine using external input sources (e.g., keyboard and mouse), thus emulating human users. All of the generation activity is "off

box" so that no generational artifacts contaminate the collected data. This is a key factor in ensuring that the collected data is free of any spurious artifacts that may incorrectly bias machine learning algorithms generated from the synthetic data.

The "off box" synthetic agents implemented by SUP will be capable of scaling to at least five hundred (500) hosts within an enterprise test network. Additionally, SUP will provide for the ability to generate and record user activity and associated data without the addition of software on the subject hosts and without relying on remote logins to the subject hosts. Ideally, the lightweight "off box" synthetic agents will be built with a language that natively supports concurrency, enabling straightforward scaling well beyond the 500-host requirement.

SUP will be able to respond correctly and continue proper operation after unexpected pop-ups and other operating system notifications occur. This will be implemented without reliance on timeouts or waiting periods to avoid unknown dialogs; and SUP will not make any assumptions as to when dialogs may or may not appear.

SUP will continue to operate properly when the screen resolution changes unexpectedly (i.e., dependencies on image matching should work at any resolution without the need for code changes or a collection of images at every possible resolution).

Within an enterprise environment, typically there are many different types of employees and departments that need to be protected, each of which may represent different types of user behavior, with communications closely matching organizational groups and software use differing as well. SUP will enable the emulation of multiple user profiles to provide a variety of realistic user behaviors across the environment. User modeling efforts may span multiple levels of complexity. For example, activities may be performed at random, quickly changing from web browsing tasks to e-mail. Alternatively, a specific workflow may be defined, providing scripts or playbooks from which to draw on actions. Finally, complex emergent behaviors may be built on models of real human behavior.

Previous work has explored many approaches to user behavior modeling. Amirkhanyan et al. [3] looked at modeling user behavior using graphical methods called user behavior state graphs. Drawing on human factors research, Garg et al. [4] included features such as nervousness, typing speed, and mouse movement behaviors into user behavior patterns that could then be replicated in a testbed environment. Blythe et. al [5] explored using the Belief-Desire-Intention model for creating intelligent agents that were capable of using planning and reaction to achieve preset goals. These methods were demonstrated as part of the Deter Agents Simulating Human-Behavior module that is a part of DeterLab [6]. Additionally, the GHOSTS-SPECTRE project has also demonstrated use of machine learning methods to drive web browsing behavior in support of data generation while modeling changing user preferences [7]. Traditionally, user data generation has used an agent "on box." The agent creates artifacts as a result of its activity and those artifacts must be filtered out if possible; otherwise, they may introduce biases into any learned algorithm.

PHASE I: This topic is soliciting Direct to Phase II (DP2) proposals only. Phase I feasibility will be demonstrated through evidence of: a completed feasibility study or a basic prototype system; definition and characterization of properties desirable for both Department of Defense (DoD) and civilian use; and comparisons with alternative state-of-the-art methodologies (competing approaches).
Proposers interested in submitting a DP2 proposal must provide documentation to substantiate that the scientific and technical merit and feasibility described above have been met and describe the potential commercial applications. DP2 documentation should include:
- technical reports describing results and conclusions of existing work, particularly regarding the commercial opportunity or DoD insertion opportunity, and risks/mitigations, and assessments;

- presentation materials and/or white papers;
- technical papers;
- test and measurement data;
- prototype designs/models;
- performance projections, goals, or results in different use cases; and,
- documentation of related topics such as how the proposed SUP solution can enable more realistic cyber training.

This collection of material will verify mastery of the required content for DP2 consideration. DP2 proposers must also demonstrate knowledge, skills, and ability in networking, computer science, mathematics, and software engineering. For detailed information on DP2 requirements and eligibility, please refer to the DoD BAA and the DARPA Instructions for this topic.

PHASE II: The goal of SUP is to generate realistic synthetic data that is void of artifacts and capable of scaling. An average cyber operator should not be able to determine that the data is synthetic by looking at the generated data, even when the operator has knowledge of typical human activity that was modeled when generating the synthetic data. The operator's view of user behavior is limited to the event activity of the user; the operator will not have visibility of the actual content created by the user. The SUP prototype should easily scale as a result of its architecture and implementation language.

DP2 proposals should present systems that:
- generate realistic synthetic data without artifacts such that an average operator cannot determine that the event data is synthetic; and
- scale to at least five hundred (500) end user machines.
- Phase II will culminate in a system demonstration using one or more compelling use cases consistent with commercial opportunities and/or insertion into a DARPA program. The below schedule of milestones and deliverables is provided to establish expectations and desired results/end products for the Phase II effort.

Deliverables must include:
- a software implementation of SUP for a virtualized test environment; and
- an example dataset generated by SUP suitable for machine learning research.

The Phase II Option period will further mature the technology for insertion into a larger DARPA Program, DoD/Intelligence Community (IC) Acquisition Program, another Federal agency; or commercialization into the private sector.

Schedule/Milestones/Deliverables: Proposers will execute the research and development (R&D) plan as described in the proposal.
- Month 1: Phase I Kickoff briefing (with annotated slides) to the DARPA Program Manager (PM) including: any updates to the proposed plan and technical approach, risks/mitigations, schedule (inclusive of dependencies) with planned capability milestones and deliverables, proposed metrics, and plan for prototype demonstration/validation.
- Months 4, 7, 10: Quarterly technical progress reports detailing technical progress made, tasks accomplished, major risks/mitigations, a technical plan for the remainder of Phase II (while this will normally report progress against the plan detailed in the proposal or presented at the Kickoff briefing, it is understood that scientific discoveries, competition, and regulatory changes may all have impacts on the planned work and DARPA must be made aware of any revisions that result), planned activities, trip summaries, and any potential issues or problem areas that require the attention of the DARPA PM.

- Month 12: Interim technical progress briefing (with annotated slides) to the DARPA PM detailing progress made (include quantitative assessment of capabilities developed to date), tasks accomplished, major risks/mitigations, planned activities, technical plan for the second half of Phase II, the demonstration/verification plan for the end of Phase II, trip summaries, and any potential issues or problem areas that require the attention of the DARPA PM.
- Month 15, 18, 21: Quarterly technical progress reports detailing technical progress made, tasks accomplished, major risks/mitigations, a technical plan for the remainder of Phase II (with necessary updates as in the parenthetical remark for Months 4, 7, and 10), planned activities, trip summaries, and any potential issues or problem areas that require the attention of the DARPA PM.
- Month 24 (Final Phase II Deliverables): Final technical progress briefing (with annotated slides) to the DARPA PM. Final architecture with documented details; a demonstration of the ability to generate artifact-free data at scale; documented application programming interfaces; and any other necessary documentation (including, at a minimum, user manuals and a detailed system design document; and the end-of-phase commercialization plan). Month 30 (Phase II Option period): Interim Option period technical progress briefing (with annotated slides) to the DARPA PM. Interim report of prototype performance against existing state-of-the-art technologies documenting key technical gaps towards productization.
- Month 36 (Phase II Option period): Final Option period technical progress briefing (with annotated slides) to the DARPA PM. Final Phase II Option period report of prototype performance against existing state-of-the-art technologies, including quantitative metrics for scalability, assessments of realism, and costs, risks, and schedule for implementation of the full prototype capability into a government-chosen test facility.

PHASE III DUAL USE APPLICATIONS: SUP has potential applicability across DoD, IC, U.S. Government (USG), and commercial entities. For DoD/IC/USG, SUP is extremely well-suited for large-scale cyber exercises, smaller-scale operator training, weapon system software testing, and automation of rote tasks. SUP has the same applicability as DoD/IC/USG for the commercial sector.

The Phase III work will be oriented towards transition and commercialization of the developed SUP technologies. The proposer is required to obtain funding from either the private sector, a non-SBIR Government source, or both, to develop the prototype into a viable product or non-R&D service for sale in military or private sector markets. Phase III refers to work that derives from, extends, or completes an effort made under prior SBIR funding agreements, but is funded by sources other than the SBIR Program. Primary SUP support will be to national efforts to explore application of artificial intelligence (AI) to improve generation of realistic user events captured during cyber-security testing on synthetic ranges. AI technologies will provide the foundation for developing sophisticated user behavior models that can be used in cyber range exercises. In particular, it is important that these models are realistic and do not bias machine learning approaches because of predictable artifacts. Results of SUP are intended to improve the quality of cyber ranges used across academia, industry, and government

REFERENCES:
1. Los Alamos National Laboratory. "Advanced Research in Cyber Systems Data Sets." Triad National Security, LLC for the U.S. Department of Energy's National Nuclear Security Administration, https://csr.lanl.gov/data/. July 5, 2022.
2. DARPA (2020) Operationally Transparent Cyber Data Release [Data Set]. Available at: https://github.com/FiveDirections/OpTC-data
3. Amirkhanyan, A., Sapegin, A., Gawron, M., Cheng, F., & Meinel, C. (2015, September). Simulation user behavior on a security testbed using user behavior states graph. In Proceedings of the 8th International Conference on Security of Information and Networks (pp. 217-223). Available at:

https://www.researchgate.net/publication/279535149_Simulation_User_Behavior_on_A_Security_Testbed_Using_User_Behavior_States_Graph

4. Garg, A., Vidyaraman, S., Upadhyaya, S., & Kwiat, K. (2006, April). USim: a user behavior simulation framework for training and testing IDSes in GUI based systems. In 39th Annual Simulation Symposium (ANSS'06) (pp. 8-pp). IEEE. Available at: https://cse.buffalo.edu/~shambhu/documents/pdf/USim.pdf

5. Blythe, J., Botello, A., Sutton, J., Mazzocco, D., Lin, J., Spraragen, M., & Zyda, M. (2011, August). Testing cyber security with simulated humans. In Twenty-Third IAAI Conference. Available at: https://www.researchgate.net/publication/221016543_Testing_Cyber_Security_with_Simulated_Humans

6. University of Southern California Information Sciences Institute (USC-ISI). "The cyber DEfense Technology Experimental Research (DETER) Lab Capabilities." The DETER Project, USC-ISI, https://deter-project.org/deterlab_capabilities#dash. July 5, 2022.

7. Carnegie Mellon University Software Engineering Institute (2020) GHOSTS-SPECTRE [Source Code] Available at: https://github.com/cmu-sei/GHOSTS-SPECTRE

KEYWORDS: Machine Learning, Cyber, Artificial Intelligence, Automation, Data, Analytics

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HR0011SB20234-03   TITLE: Space Metamaterial Electronically Scanned Array (Space-MESA)

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Space Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a proof of concept metamaterial antenna specifically designed to provide space-based detection, tracking, and imaging of moving targets. The prototype should include fabrication of a metasurface aperture (sub tile) that can support wide angle, high-speed beamsteering, as well as any testing capabilities needed for capturing full antenna patterns from the prototype.

DESCRIPTION: Providing persistent, global, space-based detection, tracking, and imaging requires high-capacity and low-cost sensors. This cost is most acutely felt in the new low-cost "proliferated" space domain where space vehicle costs have been plummeting. The most suitable type of sensor for performance is a synthetic aperture radar (SAR) due to its ability to provide fast, wide field of regard to detect, track, and image multiple moving objects of interest regardless of weather. However, SARs are not cost effective to deploy aboard spacecraft in the numbers necessary to provide a persistent, global capability. Another option could be lower-cost fixed mesh-reflectors or planar arrays as they are capable of generating adequate antenna gain, but they lack the ability to electronically steer a beam, and can only image one or two targets per pass. Due to the lack of capability offered by fixed-beam systems and the prohibitive cost of using traditional SAR-equipped satellites for global coverage, DARPA is looking for cost-effective, fully-steerable track-while-scan radars that can be deployed in low earth orbit (LEO).
To provide the cost-effective capability DARPA is looking for, metamaterial electronically scanned array (MESA) radars are of particular interest due to their ability to offer similar performance to traditional Active Electronically Scanned Arrays (AESAs), but at an order of magnitude less cost due to their simpler design. While MESAs technology has been developed for both ground and air applications, it has not yet been developed for deployment to and usage in space environments.

To detect and track objects over large areas (100s of square kilometers), the MESA would need to be constructed of coherent, digital tiles. A super-array of digital tiles though would require new means to solve coherence and calibration challenges, while also burdened with the extreme temperature variations and high orbital velocities experienced in a space environment.

In this effort, proposers will design and develop an operational electronically-steerable metamaterial antenna sub tile prototype, as well as:
• Design and develop a near-field probe antenna test system to capture full antenna patters out of the antenna prototype
• Document manufacturing development steps necessary for the metamaterial antenna
• Develop all hardware and software to control drive electronics of active components of sub-tile to electronically steer a beam.

PHASE I: This topic is soliciting Direct to Phase II (DP2) proposals only. Previous Phase 1 qualified efforts should have demonstrated that they can design and produce an electronically steerable antenna

capable of achieving the metrics listed below. Results should be supported by prior demonstration or laboratory testing.

- Steerable to ± 60° in azimuth and elevation with sub 1° steps
- Ability to survive high peak radiofrequency powers from 800W to 1200W for apertures 1m2 and greater Efficiency data of 40% or greater at broadside
- Peak sidelobe levels of 15dB or greater at broadside
- Ability to steer large apertures (150?? or greater) in 10us or less

PHASE II: The Phase II effort consists of a Phase II base of 12 months and a Phase II option of 12 months. Phase II fixed payable milestones for this program should include:

- Month 2: Initial report on architecture and program plan
- Month 6: Interim report on system trade study and architecture, antenna design, and system requirements
- Month 12: Phase II report documenting status of X-band antenna design and development, antenna test platform, antenna manufacturing process development, and hardware/software to control drive electronics progress
- Month 18: Interim report documenting X-band antenna design and fabrication, antenna test platform design, antenna manufacturing results, and hardware/software to control drive electronics progress
- Month 24: Final Phase II report documenting X-band antenna design and test results, antenna test platform design and specifications, antenna manufacturing process, and verification results of hardware and software to control drive electronics

PHASE III DUAL USE APPLICATIONS: Metasurface Electronically Scanned Array (MESA) radars are currently high technology readiness level and in full-rate production, providing high-performance at low cost for both air and ground usage, for military and commercial applications. Further developing this metamaterial antenna technology to be operable in space while providing the performance needed for wide-area moving target indication would attract significant interest from space-focused agencies within the Department of Defense, and potentially commercial partners as well.

REFERENCES:
1. https://en.wikipedia.org/wiki/Active_electronically_scanned_array
2. https://en.wikipedia.org/wiki/Metamaterial_antenna
3. https://www.microwavejournal.com/articles/27373-metamaterial-advances-for-radar-and-communications

KEYWORDS: Metamaterials, Synthetic Aperture Radar, Electronical Scanned Arrays

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APPENDIX A: DARPA DIRECT TO PHASE II (DP2) PROPOSAL INSTRUCTIONS

I.   Introduction

A complete proposal submission consists of:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume (feasibility documentation and technical proposal)
Volume 3: Cost Volume
Volume 4: Company Commercialization Report
Volume 5: Supporting Documents
Volume 6: Fraud, Waste and Abuse Training

The Defense SBIR/STTR Innovation Portal (DSIP) provides a structure for building the proposal volumes and submitting a consolidated proposal package. If this is your first time submitting an SBIR or STTR proposal using DSIP, please review detailed training guides at
https://www.dodsbirsttr.mil/submissions/learning-support/training-materials. It is the responsibility of the proposing firm to ensure that a complete proposal package is certified and submitted by the close date listed in the topic to which they are responding.

To assist in proposal development, templates for Volume 2: Technical Volume and Volume 3: Cost Volume have been provided as attachments to the announcement posted at
https://www.dodsbirsttr.mil/submissions/login Use of these templates is mandatory.

NOTE: All proposers are required to submit Volume 4: Company Commercialization Report (CCR).

II.   Proprietary Information

Proposers that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall follow instructions in section 4.5 regarding marking propriety proposal information.

III.   DP2 Proposal Instructions

   a.   Proposal Cover Sheet (Volume 1)

The Cover Sheet must include a brief technical abstract of no more than 3000 characters 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 may be publicly released.

   b.   Format of Technical Volume (Volume 2) – standard format

   1. The Technical Volume must include two parts, PART ONE: Feasibility Documentation and PART TWO: Technical Proposal.

   2. Type of file: The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus is detected, it may cause rejection of the proposal. Do not lock or encrypt the uploaded file. Do not

include or embed active graphics such as videos, moving pictures, or other similar media in the document.

3. Length: The length of each part of the technical volume (Feasibility Documentation and Technical Proposal) will be specified by the corresponding topic. The Government will not consider pages in excess of the page count limitations.

4. Layout: Number all pages of your proposal consecutively. Font size should not be 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 DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.

c. C**ontent of the Technical Volume (Volume 2) – Standard Format**

PART ONE: Feasibility Documentation
1. 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 describe 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.
2. Maximum page length for feasibility documentation will be specified by the topic. 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.
3. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the PI.
4. If technology in the feasibility documentation is subject to Intellectual Property (IP), the proposer must either own the IP, or must have obtained license rights to such technology prior to proposal submission, to enable it and its subcontractors to legally carry out the proposed work. Documentation of IP ownership or license rights shall be included in the Technical Volume of the proposal.
5. 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. 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.

PART TWO: Standard Technical Proposal (applies to both 65 and 35-page volumes)
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.
3. 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.
    a. Human/Animal Use: Proposers 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.

b. Phase II Option Statement of Work (if applicable, specified in the corresponding TOPIC). 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.

4. Related Work. Describe significant activities directly related to the proposed effort, including any conducted by the PI, the proposer, 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 proposer's awareness of the state of the art in the specific topic. Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short description, (2) client for which work was performed (including individual to be contacted and phone number) and (3) date of completion.

5. 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.

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 PI, 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.

7. Foreign Citizens. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Refer to section 3.2 of this BAA for more information. Supplemental information provided in response to this paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

8. 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.

9. Subcontractors/Consultants. Involvement of a university or other subcontractors or consultants in the project may be appropriate. If such involvement is intended, it should be identified and described according to the Cost Breakdown Guidance. Please refer to section 3 of this BAA for detailed eligibility requirements as it pertains to the use of subcontractors/consultants.

10. Prior, Current or Pending Support of Similar Proposals or Awards. If a proposal submitted in response to this topic is substantially the same as another proposal that was funded, is now being funded, or is pending with another Federal Agency, or another or the same DoD Component, you must reveal this on the Proposal Cover Sheet and provide the following information:
    a. Name and address of the Federal Agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.

b. Date of proposal submission or date of award.
c. Title of proposal.
d. Name and title of the PI for each proposal submitted or award received.
e. Title, number, and date of BAA(s) or solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
f. If award was received, state contract number.
g. Specify the applicable topics for each proposal submitted or award received.

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

11. Transition and Commercialization Strategy. DARPA is equally interested in dual use commercialization of SBIR/STTR projects that result in products sold to the U.S. military, the private sector market, or both. DARPA expects explicit discussion of key activities to achieve this result in the transition and commercialization strategy part of the proposal. The Technical Volume of each Direct to Phase II proposal must include a transition and commercialization strategy section. The Phase II transition and commercialization strategy shall not exceed 5 pages, and will NOT count against the proposal page limit.

Information contained in the commercialization strategy section will be used to determine suitability for participation in EEI. Selection for participation in EEI will be made independently following selection for SBIR/STTR award. Please refer to section 3 of the Instructions for more information on the DARPA EEI and additional proposal requirements.

The transition and commercialization strategy should include the following elements:

a. A summary of transition and commercialization activities conducted during Phase I, and the Technology Readiness Level (TRL) achieved. Discuss the market, competitive landscape, potential stakeholders and end-users, and how the preliminary transition and commercialization path or paths may evolve during the Phase II project. Describe key proposed technical milestones during Phase II that will advance the technology towards product such as: prototype development, laboratory and systems testing, integration, testing in operational environment, and demonstrations.
b. Problem or Need Statement. Briefly describe what you know of the problem, need, or requirement, and its significance relevant to a Department of Defense application and/or a private sector application that the SBIR/STTR project results would address. Is there a broader societal need you are trying to address? Please describe.
c. Description of Product(s) and/or System Application(s). Identify the commercial product(s) and/or DoD system(s), or system(s) under development, or potential new system(s). Identify the potential DoD end- users, Federal customers, and/or private sector customers who would likely use the technology.
d. Business Model(s)/Procurement Mechanism(s). Discuss your current business model hypothesis for bringing the technology to market. Describe plans to license, partner, or self-produce your product. How do you plan to generate revenue? Describe the resources you expect will be needed to implement your business models. Discuss your plan and expected timeline to secure these resources. Understanding DARPA's goal of creating and sustaining a U.S. military advantage, describe how you intend to develop your product and supply chains to enable this differentiation.
e. Target Market. Describe the market and addressable market for the innovation. Describe the customer sets you propose to target, their size, their growth rate, and the key reasons they would consider procuring the technology. Discuss the business economics and market drivers in the target industry. Describe competing technologies existent today on

the market as well as those being developed in the lab. How has the market opportunity been validated? Describe the competition. How do you expect the competitive landscape may change by the time your product/service enters the market?

f. Funding Requirements. Describe your company's funding history. How much external financing have you raised? Describe your plans for future funding sources (internal, loan, angel, venture capital, etc.).

g. Transition and Commercialization Risks. Describe the major technology, market and team risks associated with achieving successful transition of the DARPA funded technology. DARPA is not afraid to take risks but we want to ensure that our awardees clearly understand the risks in front of them. What are the key risks in bringing your innovation to market? What are actions you plan to undertake to mitigate these risks?

h. Expertise/Qualifications of Team/Company Readiness. Describe the expertise and qualifications of your management, marketing/business development and technical team that will support the transition of the technology from the prototype to the commercial market and into government operational environments. Has this team previously taken similar products/services to market? If the present team does not have this needed expertise, how do you intend to obtain it? What is the financial history and health of your company (e.g., availability of cash, profitability, revenue growth, etc.)?

i. Anticipated Transition and Commercialization Results. Include a schedule showing the anticipated quantitative transition and 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 at least annually.

Advocacy Letters (OPTIONAL)* Feedback received from potential Commercial and/or DoD customers and other end-users regarding their interest in the technology to support their capability gaps. Advocacy letters that are faxed or e-mailed separately will NOT be accepted.

Letters of Intent/Commitment (OPTIONAL)* Relationships established, feedback received, support and commitment for the technology with one or more of the following: Commercial customer, DoD PM/PEO, a Defense Prime, or vendor/supplier to the Primes and/or other vendors/suppliers identified as having a potential role in the integration of the technology into fielded systems/products or those under development. Letters of Intent/Commitment that are faxed or e- mailed separately will NOT be accepted.

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

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

d. Format of the Technical Volume (Volume 2) – White Paper & Slide Deck

1. The Technical Volume must include two parts, PART ONE: white paper and PART TWO: slide deck.

2. Type of file: The Technical Volume must be a single Portable Document Format (PDF) file, including graphics. Perform a virus check before uploading the Technical Volume file. If a virus

is detected, it may cause rejection of the proposal. Do not lock or encrypt the uploaded file. Do not include or embed active graphics such as videos, moving pictures, or other similar media in the document.

3. Length: The length of each part of the technical volume (white paper and side deck) will be specified by the corresponding TOPIC. The Government will not consider pages in excess of the page count limitations.

4. Layout: Number all pages of your proposal consecutively. Font size should not be 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 DSIP when the Cover Sheet was created. The header may be included in the one-inch margin.

e.   Content of the Technical Volume (Volume 2) – White Paper & Slide Deck

White Paper (NTE 20 pages). Provide the following information:
Goals and Impact: Clearly describe what is being proposed and what difference it will make (qualitatively and quantitatively), including a brief discussion on how this directly relates to the topic.

1. Phase I Feasibility: This topic is accepting Direct to Phase II proposals ONLY. To be eligible, proposers must demonstrate that the feasibility requirements outlined in the topic have been met, and achieved outside of the SBIR program.

2. Technical Plan: Outline and address all technical areas and challenges inherent in the approach and possible solutions for overcoming potential problems. Provide specific objectives, metrics, and milestones at intermediate stages to demonstrate a plan for accomplishment of the project objectives. Propose additional appropriate qualitative and quantitative metrics specific to the approach, as needed. Intermediary milestones should occur at no greater than 1-month increments.

3. Management and Capabilities: Designate key personnel who will be involved in the Phase II effort. Provide a brief summary of expertise of the team, including subcontractors and key personnel. Describe the organizational experience in this technology area, previous work not directly related to the proposed effort but similar, existing intellectual property required to complete the project, and any specialized facilities to be used as part of the project. List Government-furnished materials or data assumed to be available. Describe any specialized facilities to be used as part of the project, the extent of access to these facilities, and any biological containment, biosafety, and certification requirements.

4. Transition and Commercialization Plan:
    a. Describe the commercial product or DoD system to be developed.
    b. Discuss the potential end users – DoD, Federal, and/or private sector customers. Discuss your business model for this technology (i.e., how to you anticipate generating revenue with this technology?). Who are you selling to directly or indirectly, a supplier, an integrator, or an end user?
    c. Describe your company's funding history. Discuss how much additional funding above this proposed effort (include additional required technology development, staffing requirements, infrastructure requirements, IP strategy costs, etc.) that will be required to bring this technology to market and how you anticipate going about getting that funding (e.g., Govt S&T contracts, investment).

d. Describe the timeline to maturity for sales or transition to an end user. Describe your IP strategy.

e. Describe the technology, market, team and business risks associated with this proposed effort and your plan to mitigate these risks.

Slide Deck (NTE 20 slides). Provide the following information (convert the completed deck to a pdf and attach it to the white paper):

1. What are you trying to do and how does this directly relate to the topic?

2. Technology and commercial product: Specifically, what are you proposing to produce – software, system, application? Be specific on what your proposed technology development is targeting as an end state.

3. How is the technology approached today? Who is doing the research, development and delivering products/services? What are the current limitations in the technology and commercial marketplaces?

4. Technical and commercial value proposition: How have you substantiated the feasibility of your approach? What is innovative in your approach and how does it compare to the state-of-the-art? Why do you think it will be successful both from a technical and commercial perspective? If you are successful what difference will it make? Discuss your proposed business model – how do you expect to generate revenue from your technology?

5. Technical and commercial risks: What are the key technical and commercial challenges and how do you plan to address/overcome these?

6. Technical and commercial market analysis: Who will care and what will the impact be if you are successful? What/who are the markets/industries/integrators/stakeholders that would/should care?

7. Cost, schedule and milestones: Provide a summary of your cost volume. Provide a summary of your schedule and milestones. How much will your proposed effort cost in total? How long will it take? What are your technical milestones for achieving the proposed efforts? What are your transition and commercialization plan milestones? Discuss how much funding will be required to bring your proposed technology to market and execute on your proposed transition and commercialization plan. Include any funding raised to date and expected plans for raising any additional required funding (government contracting revenue, product sales, internal R&D investment, loan, angel or Venture Capital investment, etc.). Describe timeline to maturity for operational use or commercial sales.

8. Management: Overview of team, facilities and qualifications.

9. Technical summary quad chart: Use template provided at https://www.darpa.mil/work-with-us/for-small-businesses/participate-sbir-sttr-program.

10. Commercialization summary quad chart: Use the DARPA Transition and Commercialization Strategy Plan (TCSP) template, located at https://www.darpa.mil/work-with-us/for-small-businesses/commercialization-continued.

NOTE: All letters of recommendation and CVs can be loaded in Volume 5: Supporting Documents.

f. Format of Cost Volume (Volume 3)

Proposers are required to use the Direct to Phase II – Volume 3: Cost Proposal Template (Excel Spreadsheet) provided as an attachment to this announcement. The Cost Volume (and supporting documentation) DOES NOT count toward the page limit of the Technical Volume.

g. Content of the Cost Volume (Volume 3)

Some items in the Cost Breakdown Guidance below may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item.

ALL proposed costs should be accompanied by documentation to substantiate how the cost was derived. For example, if you proposed travel cost to attend a project-related meeting or conference, and used a travel website to compare flight costs, include a screen shot of the comparison. Similarly, if you proposed to purchase materials or equipment, and used the internet to search for the best source, include your market research for those items. You do not necessarily have to propose the cheapest item or supplier, but you should explain your decision to choose one item or supplier over another. It's important to provide enough information to allow contracting personnel to understand how the proposer plans to use the requested funds. If selected for award, failure to include the documentation with your proposal will delay contract negotiation, and the proposer will be asked to submit the necessary documentation to the Contracting Officer to substantiate costs (e.g., cost estimates for equipment, materials, and consultants or subcontractors). It is important to respond as quickly as possible to the Contracting Officer's request for documentation.

Cost Breakdown Guidance:
1. List all key personnel by name as well as by number of hours dedicated to the project as direct labor. 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 DARPA; unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DARPA.
2. Cost for travel funds must be justified and related to the needs of the project.
3. Cost sharing is permitted for proposals under this announcement; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.
4. All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regard to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal. Enter this information in the Explanatory Material section of the on-line cost proposal form. The Supporting Documents Volume (Volume 5) may be used if additional space is needed.

For more information about cost proposals and accounting standards, see the DCAA publication titled "Audit Process Overview – Information for Contractors" available at: http://www.dcaa.mil.

h. Company Commercialization Report (Volume 4)

The Company Commercialization Report (CCR) allows companies to report funding outcomes resulting from prior SBIR and STTR awards. The Company Commercialization Report (CCR) is required for

Phase I and Direct to Phase II proposals. Please refer to the DoD STTR Program BAA for full details on this requirement. Information contained in the CCR will not be considered by DARPA during proposal evaluations.

i. Supporting Documents (Volume 5)

In addition to required DoD documentation and certifications, small businesses may also submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3) in Volume 5.

j. Fraud Waste and Abuse (Volume 6)

The Fraud, Waste and Abuse (FWA) training is required for Phase I and Direct to Phase II proposals. FWA training provides information on what represents FWA in the SBIR/STTR program, the most common mistakes that lead to FWA, as well as the penalties and ways to prevent FWA in your firm. This training material must be thoroughly reviewed once per year. Plan ahead and leave ample time to complete this training based on the proposal submission deadline. Knowingly and willfully making any false, fictitious, or fraudulent statements or representations may be a felony under the Federal Criminal False Statement Act (18 U.S.C. Sec 1001), punishable by a fine of up to $10,000, up to five years in prison, or both. Understanding the indicators and types of fraud, waste, and abuse that can occur is critical for the SBIR/STTR awardees' role in preventing the loss of research dollars.