Broad Agency Announcement

Microsystems Technology Office (MTO) Office-wide

MICROSYSTEMS TECHNOLOGY OFFICE

HR001124S0028

May 09, 2024

This publication constitutes a Broad Agency Announcement (BAA) as contemplated in Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 and 2 CFR § 200.203. Any resultant award negotiations will follow all pertinent law and regulation, and any negotiations and/or awards for procurement contracts will use procedures under FAR 15.4, Contract Pricing, as specified in the BAA.

OVERVIEW INFORMATION:

- **Federal Agency Name:** Defense Advanced Research Projects Agency (DARPA), Microsystems Technology Office (MTO)
- **Funding Opportunity Title:** Microsystems Technology Office (MTO) Office-wide
- **Announcement Type:** Initial Announcement
- **Funding Opportunity Number:** HR001124S0028
- **Assistance Listing Number:** Not applicable
- **Dates:** (All times listed herein are Eastern Time)
  - **Posting Date:** May 9, 2024
  - **Abstract Due Date:** Abstracts may be submitted on a rolling basis until 1:00 p.m. on March 9, 2025
  - **Proposal Due Date:** Proposals may be submitted on a rolling basis until 1:00 p.m. on May 9, 2025
  - **Question Submittal Closed:** April 4, 2025 at 1:00 p.m.
- **Anticipated individual awards:** Multiple awards are anticipated
- **Anticipated funding type:** 6.1, 6.2, and/or 6.3
- **Types of instruments that may be awarded:** Procurement contract, grant, cooperative agreement or other transaction

- **Agency contact:**
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    The BAA Coordinator for this effort may be reached at:
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THOSE INTENDING TO SUBMIT A PROPOSAL FOR AN ASSISTANCE INSTRUMENT (GRANT OR COOPERATIVE AGREEMENT) ARE STRONGLY ENCOURAGED TO READ THE INSTRUCTIONS PROVIDED Proposer Instructions: Grants/Cooperative Agreements REGARDING THE TIME REQUIRED TO RECEIVE VALIDATION OF SUBMISSIONS MADE THROUGH GRANTS.GOV. PROPOSALS THAT ARE VALIDATED AFTER THE PROPOSAL DUE DATE/TIME WILL BE CONSIDERED LATE AND, AS SUCH, WILL NOT BE REVIEWED.

Section I: Funding Opportunity Description

The Defense Advanced Research Projects Agency (DARPA) often selects its research efforts through the Broad Agency Announcement (BAA) process. This BAA is being issued, and any resultant selection will be made, using the procedures under Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 and 2 C.F.R. § 200.203. Any negotiations and/or awards of procurement contracts will use procedures under FAR 15.4, Contract Pricing. Proposals received as a result of this BAA shall be evaluated in accordance with evaluation criteria specified herein through a scientific review process.

DARPA BAAs are posted on the SAM website, under the Contract Opportunities link, at https://sam.gov/, and, as applicable, the grants.gov website at http://www.grants.gov/. The following information is for those wishing to respond to the BAA.

The Microsystems Technology Office (MTO) at DARPA regularly publishes BAAs requesting responses to specific program topics. This announcement seeks revolutionary research ideas for topics not being addressed by ongoing MTO programs or other published solicitations.

To avoid proposals that duplicate existing activities or are responsive to other published MTO solicitations, potential bidders are highly encouraged to review current MTO programs and solicitations, respectively listed at http://www.darpa.mil/about-us/offices/mto and http://www.darpa.mil/work-with-us/opportunities. Contacting MTO program managers to discuss their research interests is also encouraged. A current list of program managers is available at http://www.darpa.mil/about-us/people.

A. MTO Mission and Thrust Areas

Since its inception in 1991, MTO has helped create and prevent strategic surprise through investments in compact microelectronic components such as microprocessors, microelectromechanical systems, and photonic devices. MTO's revolutionary work applying advanced capabilities in areas such as wide-band gap materials, phased array radars, high-energy lasers, and infrared imaging have helped the United States establish and maintain microsystems superiority for decades.

MTO seeks to develop high-risk, high-reward technologies that continue DARPA's mission of creating and preventing strategic surprise, help to secure the Department of Defense's (DoD's) technological superiority, and address the complex threats facing U.S. national security. Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

As MTO evolves to address future microsystems-related challenges in this unprecedented era of advancement, the office is establishing a beyond-the-headlights strategy that focuses on three heretofore nascent thrusts, each focused on addressing key challenges towards its mission to *dominate the microsystems ecology militarily and economically*:

1. **Scientific Disruption** is developing technology to enable fundamentally new ways to design and employ integrated circuits for the next generations of microsystems. While Moore's Law has shown remarkable resilience to the constant predictions of electronic transistor scaling's death over the past decade, quantum physics and Heisenberg uncertainty may prove to be an ultimate limit over the next decade. Thus, MTO is explicitly soliciting research topics that may lead to the development and proliferation of the next transistor technology and the required building blocks and manufacturing ecosystem around it. By identifying and cultivating multiple candidates, a step change to a new scaling trajectory and the microsystem dominance that comes with it may be possible. Three specific Scientific Disruption candidates, and the resulting new classes of circuits, are of interest:
    - ***Photonic circuits (PCs)***. While photonics is not new to MTO, there is still much to explore through using the power of light at the chip scale. Shifting from fermion-based electrical circuits to boson-based photonic circuits enables a massive data transport performance gain that would provide substantial asymmetric microsystem advantages. MTO intends to invest in PC technologies that expand the use of photonic interconnects, enable new materials and wavelengths, and facilitate new architecture designs.
    - ***Quantum circuits (QCs)***. Quantum phenomena are theorized to offer dramatic improvements over classical computing and sensing. The quantum technological race is occurring within academic, commercial, and government channels across a spectrum of plausible implementations. MTO intends to invest in both near- and long-term instantiations of quantum technology to reduce the possibility of commercial surprise, drive the discovery of new hardware metrics, and invent scalable devices. In addition to technologies that will directly enable QCs, MTO is also interested in foundational technologies that enable the reduction of QCs to practice, such as heterogeneously integrated cryogenic cooling, advanced superconducting junctions, and building blocks for chip-scale quantum systems.
    - ***Bio/Organic circuits (OCs)***. Biological and organic systems engage in complex computation and sensing activities continuously at an efficiency and effectiveness that often dwarfs their inorganic counterparts. MTO intends to invest in the integration of biomolecules and micro-technologies to establish the viability of OCs and explore hybrid bio-sensing and bio-compute microsystems. Disruptive research topics that support bio-based methods for high-speed, low-power compute and avenues for OCs that exceed performance of inorganic circuits are of specific interest.

2. **Microsystems manufacturing ecosystem** is developing the infrastructure needed to bring the needed sustainability to advanced microsystems. While the monetary cost of manufacturing an electronic transistor decreases as the transistor shrinks, the natural resource cost of fabricating microsystems is increasing monotonically with no relief in sight. For example, the average water usage, energy consumption, and greenhouse gas emission for each 300 mm wafer produced in 2021 was 5,810 L of water, 813 kW-hr, and 594 kg of CO2 equivalent, respectively. MTO is exploring new additive, subtractive, and hybrid fabrication tools as well as technologies for the reuse and recycling of materials, transistors, and circuits for the creation of advanced microsystems. Of specific interest

are research topics for automated control of materials synthesis for non-traditional semiconductor materials, methods to predict fabrication and integration methods with minimal data, and just-in-time application specific integrated circuit customization.

3. **Dual use by design** is recognizing that the DoD must take advantage of commercial scaling but also find ways to build superior capability into defense microsystems. The DoD's exquisite microsystem performance demands, coupled with its comparatively tiny volumes, place an inherent challenge on getting new technologies deployed at the speed and cost its warfighters require. MTO recognizes that it must strengthen its partnership with the commercial enterprise to ensure that new military microsystem technologies have the commercial viability to become self-sustaining. Such commercially catalyzed defense deployment will be purposefully pursued to ensure not only military differentiation but also economic dominance within the microsystem domain. To that end, MTO will explore new technologies in design, integration, and hardware security that lead to impactful commercialization while supporting the security and performance required for military systems.

B. Topic Areas of Interest

Research areas of current interest to MTO include, but are not limited to, the following topics:

Quantum circuits

- Fault-tolerant quantum computer modeling
- Fault-tolerant quantum computer architectures
- High efficiency quantum-optical transducers
- High-rate quantum-optical entanglement generators
- Matrixed quantum sensors for sensing and signal processing
- Methodologies and building blocks for chip-scale quantum systems
- Scalable application-specific quantum hardware
- Ultrahigh density qubit manufacturing methods

Biological circuits

- Biochemical processor alternatives
- Microsystem translators to control biological function
- Portable, customizable nanopore sensing platforms
- Self-assembled biomolecular transistors and integrated circuits

Photonic circuits

- Chip-scale hyperspectral sensors
- Low size, weight, and power conformal optical phased arrays
- Low size, weight, and power high intensity light sources
- Portable ultrahigh power terahertz emitters
- Ultrafast scattered light analyzers
- Ultrahigh-density intra-chip 3D photonic interconnects

Manufacturing Ecosystem

- Data-starved fabrication and integration process predictions
- Frameworks to accelerate electromagnetic microsystem discovery
- High density cryogenic-to-room-temperature interconnects
- Miniaturized 3D heterogeneously integrated cryogenic cooling
- Real-time closed-loop manufacturing of new materials
- Self-updating programmable assembly tools

Dual Use by Design

- Black-box model-based risk assessment frameworks
- Commercially relevant tool development challenge problems
- Customizable template application specific integrated circuits
- Electromagnetic spectrum interaction strategic emulators
- High-accuracy long range passive ranging
- High-efficiency waste heat electricity generation at the microsystem
- Low size, weight, and power passive navigation
- Plasmonic sub-terahertz amplifiers
- Tunable emissivity materials

Section II: Evaluation Criteria

- Proposals will be evaluated using the following criteria, listed in descending order of importance: Overall Scientific and Technical Merit; Potential Contribution and Relevance to the DARPA Mission; and Cost Realism.

1. **Overall Scientific and Technical Merit**: The proposed technical approach is innovative, feasible, achievable, and complete. The proposed technical team has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome that achieves the goal can be expected as a result of award. The proposal identifies major technical risks and planned mitigation efforts are clearly defined and feasible.

2. **Potential Contribution and Relevance to the DARPA Mission**:
   The potential contributions of the proposed effort bolster the national security technology base and support DARPA's mission to make pivotal early technology investments that create or prevent technological surprise.

   The proposer clearly demonstrates its plans and capabilities to contribute to U.S. national security and U.S. technological capabilities. The evaluation will consider the proposer's plans and capabilities to transition proposed technologies to U.S. national security applications and to U.S. industry. The evaluation may consider the proposer's history of transitioning or plans to transition technologies to foreign governments or to companies that are foreign owned, controlled, or influenced. The evaluation will also consider the proposer's plans and capabilities to assist its employees and agents to be eligible to participate in the U.S. national security environment.

   In addition, the evaluation will take into consideration the proposed technology transition strategy and the extent to which the proposed intellectual property (IP) rights will potentially impact the Government's ability to transition the technology, as applicable. The proposed intellectual property restrictions (if any) will not significantly impact the Government's ability to transition the technology.

3. **Cost Realism**: The proposed costs are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. The proposed costs are consistent with the proposer's Statement of Work and reflect a sufficient understanding of the costs and level of effort needed to successfully accomplish the proposed technical approach. The costs for the prime proposer and proposed sub awardees are substantiated by the details provided in the proposal (e.g., the type and number of labor hours proposed per task, the types and quantities of materials, equipment and fabrication costs, travel and any other applicable costs and the basis for the estimates).

   It is expected that the effort will leverage all available relevant prior research in order to obtain the maximum benefit from the available funding. For efforts with a likelihood of

commercial application, appropriate direct cost sharing may be a positive factor in the evaluation. DARPA recognizes that undue emphasis on cost may motivate proposers to offer low-risk ideas with minimum uncertainty and to staff the effort with junior personnel in order to be in a more competitive posture. DARPA discourages such cost strategies.

- Unless otherwise specified in this announcement, for additional information on how DARPA reviews and evaluates proposals through the Scientific Review Process, please visit: Proposer Instructions and General Terms and Conditions

Section III: Submission Information

- This announcement allows for multiple award instrument types to be awarded to include Procurement Contracts, Grants, Cooperative Agreements, and Other Transactions. Some award instrument types have specific cost-sharing requirements. The following websites are incorporated by reference and contain additional information regarding overall proposer instructions, general terms and conditions, and each specific award instrument type.

  - **Proposer Instructions and General Terms and Conditions**: Proposer Instructions and General Terms and Conditions
  - **Procurement Contracts**: Proposer Instructions: Procurement Contracts
  - **Assistance (Grants and Cooperative Agreements)**: Proposer Instructions: Grants/Cooperative Agreements
  - **Other Transaction agreements**: Proposer Instructions: Other Transactions

- This announcement contains an abstract phase. Abstracts are strongly encouraged but not required. Proposers are strongly encouraged to submit an abstract in advance of a full proposal in order to provide potential proposers with a rapid response and to minimize unnecessary effort in proposal preparation and review. Abstracts will be accepted on a rolling basis until the abstract due date outlined in this announcement. Abstracts received after this time and date may not be reviewed. The instructions for abstract submission are contained within **Attachment A**.

- Full proposals will be accepted on a rolling basis until the proposal due date outlined in this announcement. Proposals received after this deadline will not be reviewed. **Attachments B, C, D, and E** contain specific instructions and templates and constitute a full proposal submission. Please visit Proposer Instructions and General Terms and Conditions for specific information regarding submission methods through the Broad Agency Announcement Tool (BAAT).

- This announcement allows for an accelerated contract award option for selected full proposals that do not exceed $2,000,000 for proposers who have agreed to prescribed stipulations as part of their full proposal submissions. Contract awards for such proposals would be made within 30 days of the selection notification. Please see Attachments F through I for details.

- **BAA Attachments**:
  - **Attachment A**: Abstract Instructions and Template
  - **Attachment B**: Proposal Summary Slide Template
  - **Attachment C**: Proposal Instructions and Volume I Template (Technical and Management)
  - **Attachment D**: Proposal Instructions and Volume II Template (Cost)
  - **Attachment E**: MS Excel™ DARPA Standard Cost Proposal Spreadsheet
  - **Attachment F**: Accelerated Contract Award Option Description
  - **Attachment G:** Accelerated Contract Award Option – Model Contract (Large Business)
  - **Attachment H**: Accelerated Contract Award Option – Model Contract (Small Business)

- **Attachment I:** Accelerated Contract Award Option Election and Attestation Form
- **Attachment J**: MTO Controlled Unclassified Information Guide signed 11.03.2023

- DARPA will post a consolidated Question and Answer (Q&A) document on a regular basis. To access the posting go to: http://www.darpa.mil/work-with-us/opportunities. The link to the FAQ link will be under the HR001124S0028 summary. Submit your question/s by e-mail to HR001124S0028@darpa.mil. In order to receive a response sufficiently in advance of the proposal due date, send your question/s on or before the question submittal deadline outlined in announcement.

Section IV: Special Considerations

- This announcement, stated attachments, and websites incorporated by reference constitute the entire solicitation. In the event of a discrepancy between the announcement, attachments, or websites, the announcement shall take precedence.

- All responsible sources capable of satisfying the Government's needs, including both U.S. and non U.S. sources, may submit a proposal that shall be considered by DARPA. Historically Black Colleges and Universities, Small Businesses, Small Disadvantaged Businesses and Minority Institutions are encouraged to submit proposals and join others in submitting proposals; however, no portion of this announcement will be set aside for these organizations' participation due to the impracticality of reserving discrete or severable areas of this research for exclusive competition among these entities. Non-U.S. organizations and/or individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

- As of the time of publication of this solicitation, all proposal submissions are anticipated to be unclassified.

- This program is subject to Attachment J: MTO General Controlled Unclassified Information (CUI) Guide signed November 3, 2023. All individuals accessing CUI agree to protect CUI in accordance with *DoD Instruction 5200.48 CONTROLLED UNCLASSIFIED INFORMATION (CUI)* and *NIST Special Publication 800-171 Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations*.

- Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers, and Government entities interested in proposing to this BAA should first contact the Agency Point of Contact (POC) listed in the Overview section prior to the Abstract due date to discuss eligibility. Complete information regarding eligibility can be found at Proposer Instructions and General Terms and Conditions.

- As of the date of publication of this solicitation, the Government expects that the BAA goals and objectives as described herein may be met by proposed efforts for fundamental research and non-fundamental research. Some proposed research may present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Based on the anticipated type of proposer (e.g., university or industry) and the nature of the solicited work, the Government expects that some awards will include restrictions on the resultant research that will require the awardee to seek DARPA permission before publishing any information or results relative to the program. For additional information on fundamental research, please visit Proposer Instructions and General Terms and Conditions.

  Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to determine

whether the proposed research shall be considered fundamental and to select the award instrument type. Appropriate language will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate. This language can be found at Proposer Instructions and General Terms and Conditions.

For certain research projects, it may be possible that although the research to be performed by a potential awardee is non-fundamental research, its proposed subawardee's effort may be fundamental research. It is also possible that the research performed by a potential awardee is fundamental research while its proposed subawardee's effort may be non-fundamental research. In all cases, it is the potential awardee's responsibility to explain in its proposal which proposed efforts are fundamental research and why the proposed efforts should be considered fundamental research.

- DARPA's Fundamental Research Risk-Based Security Review Process (formerly CFIP, now FERBS) is an adaptive risk management security program designed to help protect the critical technology and performer intellectual property associated with DARPA's research projects by identifying the possible vectors of undue foreign influence. The DARPA team will create risk assessments of all proposed Senior/Key Personnel selected for negotiation of a fundamental research grant or cooperative agreement award. The DARPA risk assessment process will be conducted separately from the DARPA scientific review process and adjudicated prior to final award. For additional information on this process, please visit Proposer Instructions: Grants/Cooperative Agreements.

- Per Section 8123 of the Department of Defense Appropriations Act, 2015 (Pub. L. 113-235), all grant awards must be posted on a public website in a searchable format. To comply with this requirement, proposers requesting grant awards must submit a maximum one (1) page abstract that may be publicly posted and explains the program or project to the public. The proposer should sign the bottom of the abstract confirming the information in the abstract is approved for public release. Proposers are advised to provide both a signed PDF copy, as well as an editable (e.g., Microsoft word) copy. Abstracts contained in grant proposals that are not selected for award will not be publicly posted.

- Proposals could potentially include Human Subjects Research (HSR) and/or Animal Use. Proposers that anticipate involving human subjects or animals in the proposed research must comply with the approval procedures detailed at Human Subjects and Animal Subjects Research, to include providing the information specified therein as required for proposal submission.

- DARPAConnect offers free resources to potential performers to help them navigate DARPA, including "Understanding DARPA Award Vehicles and Solicitations," "Making the Most of Proposers Days," and "Tips for DARPA Proposal Success." Join DARPAConnect at www.DARPAConnect.us to leverage on-demand learning and networking resources.

- The APEX Accelerators program, formerly known as the Procurement Technical Assistance Program (PTAP), focuses on building a strong, sustainable, and resilient U.S. supply chains

by assisting a wide range of businesses that pursue and perform under contracts with the DoD, other federal agencies, state and local governments and with government prime contractors. See https://www.apexaccelerators.us/ for more information. APEX Accelerators helps businesses:

  - Complete registration with a wide range of databases necessary for them to participate in the government marketplace (e.g., SAM).
  - Identify which agencies and offices may need their products or services and how connect with buying agencies and offices.
  - Determine whether they are ready for government opportunities and how to position themselves to succeed.
  - Navigate solicitations and potential funding opportunities.
  - Receive notifications of government contract opportunities on a regular basis.
  - Network with buying officers, prime contractors, and other businesses.
  - Resolve performance issues and prepare for audit, only if the service is needed, after receiving an award.

- Project Spectrum is a nonprofit effort funded by the DoD Office of Small Business Programs to help educate the Defense Industrial Base (DIB) on compliance. Project Spectrum is vendor-neutral and available to assist businesses with their cybersecurity and compliance needs. Their mission is to improve cybersecurity readiness, resilience, and compliance for small/medium-sized businesses and the federal manufacturing supply chain. Project Spectrum events and programs will enhance awareness of cybersecurity threats within the manufacturing, research and development, as well as knowledge-based services sectors of the industrial base. Project Spectrum will leverage strategic partnerships within and outside of the DoD to accelerate the overall cybersecurity compliance of the DIB.

  www.Projectspectrum.io is a web portal that will provide resources such as individualized dashboards, a marketplace, and Pilot Program to help accelerate cybersecurity compliance.

- DARPA has streamlined our Broad Agency Announcements and is interested in your feedback on this new format. Please send any comments to DARPAsolicitations@darpa.mil