



Broad Agency Announcement

DARPA-BAA-09-26

Optical Radiation Cooling and Heating in Integrated  
Devices  
(ORCHID)

Microsystems Technology Office (MTO)

April 15, 2009

Originating Program Manager: Dr. Henryk Temkin  
Operating Program Manager: Dr. Joseph Mangano

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## Part One: Overview Information

1. **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Microsystems Technology Office (MTO)
2. **Funding Opportunity Title** – Optical Radiation Cooling and Heating in Integrated Devices (ORCHID)
3. **Announcement Type** – Broad Agency Announcement (BAA)
4. **Funding Opportunity Number** – DARPA-BAA-09-26
5. **Catalog of Federal Domestic Assistance Numbers (CFDA)** – 12.910 Research and Technology Development
6. **Dates**
  - Posting Date: 15 April 2009
  - Proposal Abstract Due Date: 15 May 2009
  - Proposal Due Date: 15 July 2009
7. **Concise description of the funding opportunity** – DARPA is soliciting innovative research and development (R&D) proposals in the area of cavity-optomechanics. While mechanical properties of light have long been understood, the idea that light can be used to effectively damp the motion of a macroscopic object is quite new. The ORCHID program is focused on exploiting optomechanical interactions between high-Q optical cavities coupled with high-Q mechanical resonators to damp or amplify the motion of macroscopic mechanical devices. In this context, damping does not lower the bulk temperature of a device; instead it affects only a few of the device's vibrational modes. However, it is these same vibrational modes that can perform transduction in mechanical sensors. As a result, this type of damping can be used to control (in situ) the dynamic range and bandwidths of mechanical sensors and to remove constraints imposed by thermal noise. When optomechanical damping (cooling) is strong enough to remove phonons from the relevant modes, the quantum mechanical properties of the device are expected to become manifest, enabling entirely new sensing and signal processing functionality. By contrast, when phonon energy is transferred from the optical cavity to the mechanical oscillator, its motion can be amplified. Thus, another aspect of the ORCHID program focuses on the development of high frequency regenerative optomechanical oscillators. These oscillators are expected to exhibit reduced linewidth and phase noise. They will be unique in the world of oscillators, as they will feature purely optical input and output for both power and signal.
8. **Anticipated individual awards** – Multiple awards are anticipated.
9. **Types of instruments that may be awarded** – Procurement contract, grant, cooperative agreement or other transaction.

**10. Agency contact**

The BAA Coordinator for this effort can be reached at:

DARPA/MTO  
ATTN: DARPA-BAA-09-26  
3701 North Fairfax Drive  
Arlington, VA 22203-1714

FAX: (703) 496-2069  
EMAIL: [DARPA-BAA-09-26@darpa.mil](mailto:DARPA-BAA-09-26@darpa.mil)

## **Part Two: Full Text of Announcement**

### **I. FUNDING OPPORTUNITY DESCRIPTION**

The Defense Advanced Research Projects Agency often selects its research efforts through the Broad Agency Announcement (BAA) process. The BAA will appear first on the FedBizOpps website, <http://www.fedbizopps.gov/>, and Grants.gov website at <http://www.grants.gov/>. The following information is for those wishing to respond to the BAA.

DARPA is soliciting innovative research proposals in the area of cavity-optomechanics. Proposed research should investigate approaches that enable advances in the exploitation of the radiation pressure of light to damp or amplify selected vibrational modes of a mechanical oscillator coupled to an optical cavity. The program is designed to encourage research that results in revolutionary, as opposed to evolutionary, improvements in the existing state of practice.

#### **BACKGROUND AND DESCRIPTION**

Selected vibrational modes of a mechanical oscillator coupled to an optical cavity can be damped (cooled) or amplified by radiation pressure. While mechanical properties of light have long been understood, the realization that light can be used to effectively damp or amplify the motion of a *macroscopic* object is quite new. It is envisioned that this new damping technique will ultimately lead to the demonstration of a macroscopic object that behaves in an inherently quantum mechanical manner.

The ORCHID program is focused on exploiting optomechanical interactions to damp or amplify the motion of macroscopic mechanical devices. In this context, damping does not lower the bulk temperature of the mechanical element; instead it affects only a few of the device's vibrational modes. However, it is these same vibrational modes that can perform transduction in mechanical sensors. As a result, this type of damping can be used to control (*in situ*) the dynamic range and bandwidth of mechanical sensors and to remove constraints imposed by thermal noise.

When optomechanical damping (cooling) is strong enough to remove all thermal phonons from a particular mode, the quantum mechanical properties of the device are expected to become manifest. In this quantum regime, entirely new sensing and signal processing functionality is expected. Reaching and exploiting this regime is a major goal of the ORCHID program.

When energy is transferred from the optical cavity to the mechanical oscillator, its motion can be amplified. Thus, another aspect of the ORCHID program focuses on the development of high-frequency regenerative optomechanical oscillators, which are expected to exhibit reduced linewidth and phase noise. These oscillators are unique in that they feature purely optical input and output signals. Additionally, the ability to

magnify small motion using low-noise optomechanical amplification could greatly impact sensor and actuator technology.

## PROGRAM OBJECTIVES AND STRUCTURE

The ORCHID program will leverage recent successes within the field of cavity-optomechanics to drive technological development in the area of micro-mechanical interactions with light. Specifically, DARPA is interested in developing integrated devices comprised of a high-Q optical cavity coupled to a high-Q mechanical resonator.

To this end, DARPA welcomes proposals in the following areas:

- Precision measurements, including low-noise interferometry and mass-sensing
- High-sensitivity bolometers
- Low-noise light sources
- Broadband, non-destructive detection of photons (catch and release)
- Light-driven modulators

In addition, DARPA welcomes proposals exploring other device applications, particularly those that lead to control of macroscopic objects at the quantum limit. However, all proposed applications must be specific and provide well-defined goals. Proposals *broadly* exploring new aspects of cavity-optomechanics are discouraged.

Useful devices will rely critically on the strong coupling between the optical field and mechanical resonator while minimizing the deleterious effects of noise. To this end, DARPA will use a figure-of-merit, the “Z-parameter”, aimed at aggressively driving the program toward this goal. This metric aims to be “system-agnostic”, creating a quantitative means to compare optomechanical device performance regardless of application or implementation. With the exception of device-packaging requirements, this Z-parameter will be the lone DARPA-defined metric for program. All devices are expected to meet this metric regardless of application.

The Z-parameter is defined as:

$$Z \equiv \frac{\hbar g_{OM}^2 Q_M}{\gamma_O^3 m} \frac{\hbar \omega_M}{k_B T_b}$$

or, alternatively, expressed in measurable system parameters:

$$Z \equiv \frac{\hbar g_{OM}^2 Q_O^3 Q_M}{\omega_O^3 m} \frac{\hbar \omega_M}{k_B T_b}$$

$m$  : Effective mass<sup>1</sup> of the mechanical element  
 $\omega_M$  : Mechanical frequency  
 $Q_M$  : Mechanical resonator quality factor  
 $\omega_O$  : Optical frequency  
 $Q_O$  : Optical cavity quality factor  
 $\gamma_O$  : Optical cavity bandwidth ( $= \omega_O/Q_O$ )  
 $g_{OM}$  : Optomechanical coupling sensitivity ( $\equiv d\omega_O/dx$ )  
 $T_b$  : Thermal bath temperature ( $= 300$  K)

(Subscripts denote:  $M \rightarrow$  mechanical,  $O \rightarrow$  optical,  $OM \rightarrow$  optomechanical)

An in-depth discussion of the Z-parameter is provided in the Technical Notes section.

Finally, practical optomechanical devices will need to operate under ambient conditions. Ultimately, all devices developed under ORCHID are expected to function *without conventional refrigeration*, regardless of application.

## PROGRAM METRICS

DARPA has established aggressive metrics for the ORCHID program. All devices are expected to meet these metrics, regardless of their particular architecture or application. In addition to the metrics listed in the Program Metrics Table, individual proposers are expected to provide device-specific Go/No-Go (GNG) metrics for each phase by which their progress can be judged. The proposed metrics must be quantitative and measurable. Proposer-defined metrics may utilize conventional refrigeration techniques in Phase I as necessary for proof-of-concept demonstrations, but Phase II devices must operate at room temperature. DARPA requires that the general program metrics described in the Program Metrics Table, along with the proposer-defined metrics, be met in each phase. Experiments are expected to be supported by detailed performance and noise analysis. If applicable, comparing device performance to the standard quantum limit is of particular interest.

DARPA expects on-chip integration of the active optomechanical system. Such integration can be accomplished using MEMS techniques or heterogeneous chip assembly. For Phase I it is acceptable to assemble the active device by conjoining an integrated chip and conventionally manufactured components, creating a “hybrid” system of integrated and discrete components. Working toward integration goals, DARPA has specified an upper limit on the size of the optomechanical device. It is acceptable for a heterogeneous chip assembly to utilize off-chip alignment or actuation stages, which will not be included as part of the active device size. By the end of Phase II, all functional components, with the exception of lasers and detectors, must be manufactured on a common chip.

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<sup>1</sup> M. Pinard, Y. Hadjar, A. Heidmann, Eur. Phys. J. D 7, 107 (1999).

**Program Metrics Table**

Parameter	State-of-the-Art	Phase I	Phase II
Z	$\sim 10^{-11}$	$10^{-9}$	$10^{-6}$
Maximum Device Size (cm)	-	10 x 10 x 5	5 x 5 x 2
Operating Temperature ( $T_b$ )	-	300 K*	300 K
Active Device <sup>§</sup>	No	Yes	Yes
Structure Type	Optical Bench	Hybrid <sup>†</sup>	Integrated on chip <sup>††</sup>

\* Z-parameter must be achieved at 300 K. Proposer-defined metrics may employ conventional cooling in Phase I for proof-of-concept demonstration only.

§ To be defined by proposers, together with device metrics.

† Allows for some conventional components of the optical cavity or mechanical resonator to be inserted on-chip. Assembly may include off-chip alignment or actuation stages.

†† All components, excluding lasers and detectors, must be constructed on a common chip.

## DELIVERABLES

At the conclusion of Phase II the Government expects to be able to test devices to validate that performance is consistent with the program metrics. Such device deliverables must be submitted for testing to a Government entity identified by DARPA. Device details and the deliverable schedule should be clearly outlined in the proposal.

## TECHNICAL NOTES

### *Definition of the “Z-parameter”*

Drawing inspiration from amplifiers, the Z-parameter is chosen to favor devices that maximize their gain-bandwidth product while limiting the noise they imprint on the signal. The Z-parameter is defined as

$$Z \equiv \frac{G \cdot \gamma}{N}$$

where  $G$  is the gain of the device,  $\gamma$  is its operational bandwidth, and  $N$  is the relevant noise parameter.

### *Optomechanical Gain Parameter ( $G_{OM}$ )*

Optomechanical schemes such as amplification and cooling rely on strong coupling between the optical field and mechanical resonator. The coupling strength can be characterized in terms of the radiation pressure induced mechanical damping/amplification. The radiation force on the mechanical element is simply the incident photon rate multiplied by the momentum transfer per photon. If  $U_O$  is the optical energy in the cavity, with the photon transit time given by the inverse of the free spectral range  $\omega_{FSR}^{-1}$ , the optical force is

$$F_o = \left( \frac{U_o}{\hbar \omega_o} \omega_{FSR} \right) \cdot \frac{2\hbar \omega_o}{c} \sim \frac{U_o}{c} \omega_{FSR}$$

This optical force displaces the mechanical element by  $\Delta x$ , modifying the cavity energy and the corresponding optical force.

$$\begin{aligned} U_o(\Delta x) &\cong U_o(0) + \frac{dU_o}{dx} \Delta x \\ F_o(\Delta x) &\cong F_o(0) + f(\Delta x) \\ &\cong F_o(0) + \frac{dU_o}{dx} \frac{\omega_{FSR}}{c} \Delta x \end{aligned}$$

The energy initially stored in the cavity is simply the input optical power multiplied by the cavity ringdown time  $U_o(0) \sim P_i \cdot \gamma_o^{-1}$ , where the ringdown time is the inverse of the cavity bandwidth (cavity damping rate). Using the relation

$$\frac{dU_o}{dx} = \frac{dU_o}{d\omega_o} \frac{d\omega_o}{dx} \sim \frac{U_o(0)}{\gamma_o} g_{OM} \sim \frac{P_i}{\gamma_o^2} g_{OM}$$

where the energy-frequency sensitivity is approximated by the initial energy divided by the cavity bandwidth  $dU_o/d\omega_o \sim U_o(0)/\gamma_o$ . The position dependent component of the optical force is given by

$$f_o(\Delta x) \sim \frac{P_i}{\gamma_o^2} g_{OM} \frac{\omega_{FSR}}{c} \Delta x$$

As the mechanical element is displaced, the finite ringdown time of the cavity causes a small lag between the optical force and the mechanical motion, leading to a component of the optical force that is out-of-phase with the motion (hence a *velocity-dependent* damping/amplification force). The phase shift is given by the product of the mechanical frequency and the cavity ringdown time  $\omega_M \cdot \gamma_o^{-1}$ . Therefore, the damping/amplification force is

$$F_{damp} = f_o(\Delta x) \cdot \omega_M \gamma_o^{-1} \cong \frac{P_i}{\gamma_o^3} g_{OM} \frac{\omega_{FSR}}{c} \omega_M \Delta x$$

Recognizing the velocity of the element as  $v = \omega_M \Delta x$ , the optomechanical damping/amplification parameter is

$$\gamma_{OM} = \frac{F_{damp}}{mv} = \frac{g_{OM}^2 Q_o^3}{m \omega_o^4} P_i$$

where we have used  $\omega_{FSR} \sim cg_{OM}/\omega_0$  ( $g_{OM} = \omega_0/\ell_{OM} \sim \omega_0/c \cdot \omega_{FSR}$ , where  $\ell_{OM}$  is the characteristic optomechanical cavity length) and expressed the damping/amplification in terms of measurable parameters. Finally, the optomechanical damping/amplification rate must be normalized by the bare mechanical damping rate (mechanical bandwidth)  $\gamma_M \sim \omega_M/Q_M$  and the incoming photon flux to arrive at the system-independent “optomechanical gain” parameter.

$$G_{OM} = \frac{\gamma_{OM}}{\gamma_M} \frac{\hbar\omega_0}{P_i} = \frac{\hbar g_{OM}^2 Q_O^3 Q_M}{\omega_M \omega_0^3 m}$$

#### *Gain-Bandwidth Product ( $G_{OM} \cdot \gamma_M$ )*

The gain-bandwidth product opens the trade space for optomechanical systems by eliminating the penalty paid by devices that operate over a large frequency range at the expense of reduced optomechanical coupling strength. Here the standard definition of bandwidth is used for the mechanical oscillator, given by the resonance frequency divided by the quality factor,

$$\gamma_M = \frac{\omega_M}{Q_M}$$

As intended, this results in a gain-bandwidth product that does not reward high mechanical-Q.

$$G_{OM} \cdot \gamma_M = \frac{\hbar g_{OM}^2 Q_O^3}{\omega_0^3 m}$$

Although the mechanical frequency has also been eliminated from the gain-bandwidth product, higher operation frequency is rewarded implicitly, since it is typically achieved by reducing effective mass.

#### *Thermal Noise Parameter ( $N_T$ )*

As stated in the metrics, DARPA expects candidate devices to operate under ambient conditions ( $\sim 300$  K). Given this requirement, thermal noise is expected to place a practical limit on the performance of these devices. The number of stored thermal phonons provides a measure of the intrinsic noise driven into the mechanical oscillator from the bath,

$$n \sim \frac{k_B T_b}{\hbar\omega_M}$$

where  $T_b$  is the bath temperature. The rate at which thermal phonons enter the mechanical oscillator from the bath is  $n \cdot \gamma_M$ . In order not to penalize high-bandwidth devices this rate must be normalized by the operating frequency. Therefore, the thermal noise parameter is defined as,

$$N_T = \frac{n\gamma_M}{\omega_M} = \frac{k_B T_b}{\hbar\omega_M} \cdot \frac{1}{Q_M}$$

*Z-Parameter (Z)*

Collecting terms, the Z-parameter is defined as

$$\begin{aligned} Z &\equiv \frac{G_{OM} \cdot \gamma_M}{N_T} \\ &= \frac{\hbar g_{OM}^2 Q_O^3 Q_M}{\omega_O^3 m} \frac{\hbar\omega_M}{k_B T_b} \\ &\left( = \frac{\hbar g_{OM}^2 Q_M}{\gamma_O^3 m} \frac{\hbar\omega_M}{k_B T_b} \right) \end{aligned}$$

Noting again that the optomechanical coupling sensitivity is the ratio of cavity detuning to the mechanical displacement, we take  $g_{OM} \equiv \omega_O/\ell_{OM}$ . Defining an *optomechanical* finesse as  $F_{OM} \equiv Q_O(\lambda_O/\ell_{OM})$ , the Z-parameter can be equivalently written as

$$Z = \frac{\hbar F_{OM}^2 Q_O Q_M}{2\pi c \lambda_O m} \frac{\hbar\omega_M}{k_B T_b}$$

Note that  $F_{OM}$  is the optical finesse for the special case of a Fabry-Perot cavity, where  $\ell_{OM}$  is the cavity length.

It is noted that  $Z$  is a dimensionless parameter that depends on all relevant optomechanical system parameters. As should be the case,  $Z$  rewards narrow cavity bandwidth, high mechanical-Q, high operation frequency, and low effective mass. The Z-parameter is calculated below for three state-of-the-art optomechanical systems. Remarkably, all three achieve comparable Z-parameters despite vastly differing architectures and applications.

**State-of-the-Art Optomechanical Systems**

Parameter	Membrane <sup>2</sup>	Microtoroid <sup>3</sup>	Zipper <sup>4</sup>
$m$	40 ng	20 ng	20 pg
$Q_M$	$10^6$	$10^3$	$10^4$
$\omega_M$	0.13 MHz	50 MHz	10 MHz
$g_{OM}$	$\omega_O \cdot (6 \text{ cm})^{-1}$	$\omega_O \cdot (500 \text{ }\mu\text{m})^{-1}$	$\omega_O \cdot (1 \text{ }\mu\text{m})^{-1}$
$Q_O$	$10^9$	$5 \cdot 10^7$	$3 \cdot 10^4$
$F_{OM}$	$1.5 \cdot 10^4$	$10^5$	$3 \cdot 10^4$
$Z$	$5 \cdot 10^{-12}$	$10^{-11}$	$10^{-12}$

Note:  $\lambda_O = 2\pi c/\omega_O = 1 \text{ }\mu\text{m}$

**II. AWARD INFORMATION**

Multiple awards are anticipated. The amount of resources made available under this BAA will depend on the quality of the proposals received and the availability of funds.

The Government reserves the right to select for negotiation all, some, one, or none of the proposals received in response to this solicitation, and to make awards without discussions with proposers. The Government also reserves the right to conduct discussions if it is later determined to be necessary. 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. If the proposed effort is inherently divisible and nothing is gained from the aggregation, proposers should consider submitting it as multiple independent efforts. The Government reserves the right to fund proposals in phases with options for continued work at the end of one or more of the phases.

Awards under this BAA will be made to proposers on the basis of the evaluation criteria listed below (see section labeled “Application Review Information”, Sec. V.), and program balance to provide overall value to the Government. Proposals identified for negotiation may result in a procurement contract, grant, cooperative agreement, or other transaction depending upon the nature of the work proposed, the required degree of interaction between parties, and other factors. The Government reserves the right to request any additional, necessary documentation once it makes the award instrument determination. Such additional information may include but is not limited to Representations and Certifications. The Government reserves the right to remove proposers from award consideration should the parties fail to reach agreement on award terms, conditions and cost/price within a reasonable time or the proposer fails to timely provide requested additional information.

As of the date of publication of this BAA, DARPA expects that program goals for this BAA may be met by proposers intending to perform 'fundamental research,' i.e., basic

<sup>2</sup> J. D. Thompson *et al.*, Nature 452, (2008)

<sup>3</sup> Schliesser *et al.*, PRL 97, 243905 (2006), Schliesser *et al.* Nature Physics VOL 4 MAY (2008)

<sup>4</sup> Matt Eichenfield *et al.*, arXiv:0812.2953v1

and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization the results of which ordinarily are restricted for proprietary or national security reasons. Notwithstanding this statement of expectation, DARPA is not prohibited from considering and selecting research proposals that, while perhaps not qualifying as 'fundamental research' under the foregoing definition, still meet the BAA criteria for submissions. In all cases, the contracting officer shall have sole discretion to select award instrument type and to negotiate all instrument provisions with selectees.

### **III. ELIGIBILITY INFORMATION**

#### **A. Eligible Applicants**

All responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA. Historically Black Colleges and Universities (HBCUs), Small Businesses, Small Disadvantaged Businesses and Minority Institutions (MIs) 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.

Federally Funded Research and Development Centers (FFRDCs) and Government entities (Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations and cannot propose to this BAA in any capacity unless they meet the following conditions. FFRDCs must clearly demonstrate that the work is not otherwise available from the private sector AND they must also provide a letter on letterhead from their sponsoring organization citing the specific authority establishing their eligibility to propose to government solicitations and their compliance with the associated FFRDC sponsor agreement and terms and conditions. This information is required for FFRDCs proposing to be prime or subcontractors. Government entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority (as well as, where relevant, contractual authority) establishing their ability to propose to Government solicitations. At the present time, DARPA does not consider 15 U.S.C. 3710a to be sufficient legal authority to show eligibility. While 10 U.S.C. 2539b may be the appropriate statutory starting point for some entities, specific supporting regulatory guidance, together with evidence of agency approval, will still be required to fully establish eligibility. DARPA will consider eligibility submissions on a case-by-case basis; however, the burden to prove eligibility for all team members rests solely with the Proposer. Proposer's failure to prove eligibility for all team members prior to the start of the agency-scheduled evaluations may result in nonselectability of the proposal.

Foreign participants and/or individuals may participate to the extent that such participants comply with any necessary Non-Disclosure Agreements, Security Regulations, Export Control Laws, and other governing statutes applicable under the circumstances.

Applicants considering classified submissions (or requiring access to classified information during the life-cycle of the program) shall ensure all industrial, personnel, and information system processing security requirements are in place and at the appropriate level (e.g., Facility Clearance (FCL), Personnel Security Clearance (PCL), certification and accreditation (C&A)) and any Foreign Ownership Control and Influence (FOCI) issues are mitigated prior to such submission or access. Additional information on these subjects can be found at: [www.dss.mil](http://www.dss.mil).

### **1. Procurement Integrity, Standards of Conduct, Ethical Considerations, and Organizational Conflicts of Interest**

Current federal employees are prohibited from participating in particular matters involving conflicting financial, employment, and representational interests (18 USC 203, 205, and 208.) Once the proposals have been received and prior to the start of proposal evaluations, the Government will assess whether any potential conflict of interest exists in regards to the DARPA Program Manager, as well as those individuals chosen to evaluate proposals received under this BAA. The Program Manager is required to review and evaluate all proposals received under this BAA and to manage all selected efforts. The DARPA Program Manager for this BAA is Joe Mangano. As of the date of first publication of the BAA, the Government has identified Science Research Laboratory (SRL) as a conflict of interest involving this program manager. Proposers should carefully consider the composition of their performer team before submitting a proposal to this BAA.

All Proposers and proposed subcontractors must affirm whether they are providing scientific, engineering, and technical assistance (SETA) or similar support to any DARPA technical office(s) through an active contract or subcontract. All affirmations must state which office(s) the Proposer supports and identify the prime contract numbers. Affirmations shall be furnished at the time of proposal submission. All facts relevant to the existence or potential existence of organizational conflicts of interest (FAR 9.5) must be disclosed. The disclosure shall include a description of the action the Proposer has taken or proposes to take to avoid, neutralize, or mitigate such conflict. In accordance with FAR 9.503 and without prior approval or a waiver from the DARPA Director, a Contractor cannot simultaneously be a SETA and Performer. Proposals that fail to fully disclose potential conflicts of interests and/or do not have plans to mitigate this conflict will be rejected without technical evaluation and withdrawn from further consideration for award.

DARPA plans one or more of its proposal evaluators or subject matter experts from other Federal agencies (primarily from the Department of Defense (DoD)). In order to avoid potential conflicts of interest, proposers should, as indicated below, contact DARPA prior to submission of their proposal if use of a Federal agency (i.e., NIST, NRL, AFRL, ARL,

etc.) as a team member is anticipated. Such notification may be provided in the proposal abstract, if applicable.

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

If a prospective Proposer believes that any conflict of interest exists or may exist (whether organizational or otherwise), the Proposer should promptly raise the issue with DARPA by sending Proposer's contact information and a summary of the potential conflict by email to the mailbox address for this BAA at DARPA-BAA-09-26@darpa.mil, before time and effort are expended in preparing a proposal and mitigation plan. If, in the sole opinion of the Government after full consideration of the circumstances, any conflict situation cannot be effectively mitigated, the proposal may be rejected without technical evaluation and withdrawn from further consideration for award under this BAA.

### **B. Cost Sharing/Matching**

Cost sharing is not required for this particular program; however, cost sharing will be carefully considered where there is an applicable statutory condition relating to the selected funding instrument (e.g., for any Other Transactions under the authority of 10 U.S.C. § 2371). Cost sharing is encouraged where there is a reasonable probability of a potential commercial application related to the proposed research and development effort.

### **C. Other Eligibility Criteria (optional)**

#### **1. Collaborative Efforts**

Collaborative efforts/teaming are encouraged.

## **IV. APPLICATION AND SUBMISSION INFORMATION**

### **A. Address to Request Application Package**

This solicitation contains all information required to submit a proposal. No additional forms, kits, or other materials are needed. This notice constitutes the total BAA. No additional information is available, nor will a formal Request for Proposal (RFP) or

additional solicitation regarding this announcement be issued. Requests for same will be disregarded.

## **B. Content and Form of Application Submission**

### **1. Security and Proprietary Issues**

**NOTE: If proposals are classified, the proposals must indicate the classification level of not only the proposal itself, but also the anticipated award document classification level.**

The Government anticipates proposals submitted under this BAA will be unclassified. However, if a proposal is submitted as “Classified National Security Information” as defined by Executive Order 12958 as amended, then the information must be marked and protected as though classified at the appropriate classification level and then submitted to DARPA for a final classification determination.

Proposers choosing to submit a classified proposal from other classified sources must first receive permission from the respective Original Classification Authority in order to use their information in replying to this BAA. Applicable classification guide(s) should also be submitted to ensure the proposal is protected at the appropriate classification level.

Classified submissions shall be appropriately and conspicuously marked with the proposed classification level and declassification date. Submissions requiring DARPA to make a final classification determination shall be marked as follows:

CLASSIFICATION DETERMINATION PENDING. Protect as though classified (insert the recommended classification level: (e.g., Top Secret, Secret or Confidential))

Classified submissions shall be in accordance with the following guidance:

**Confidential and Secret Collateral Information:** Use classification and marking guidance provided by previously issued security classification guides, the Information Security Regulation (DoD 5200.1-R), and the National Industrial Security Program Operating Manual (DoD 5220.22-M) when marking and transmitting information previously classified by another Original Classification Authority. Classified information at the Confidential and Secret level may be mailed via appropriate U.S. Postal Service methods (e.g., (USPS) Registered Mail or USPS Express Mail). All classified information will be enclosed in opaque inner and outer covers and double wrapped. The inner envelope shall be sealed and plainly marked with the assigned classification and addresses of both sender and addressee. The inner envelope shall be address to:

Defense Advanced Research Projects Agency  
ATTN: Microsystems Technology Office (MTO)  
Reference: DARPA-BAA-09-26  
3701 North Fairfax Drive  
Arlington, VA 22203-1714

The outer envelope shall be sealed with no identification as to the classification of its contents and addressed to:

Defense Advanced Research Projects Agency  
Security & Intelligence Directorate, Attn: CDR  
3701 North Fairfax Drive  
Arlington, VA 22203-1714

**All Top Secret materials**: Top Secret information should be hand carried by an appropriately cleared and authorized courier to the DARPA CDR. Prior to traveling, the courier shall contact the DARPA CDR at 571 218-4842 to coordinate arrival and delivery.

**Special Access Program (SAP) Information**: SAP information must be transmitted via approved methods. Prior to transmitting SAP information, contact the DARPA SAPCO at 703-526-4052 for instructions.

**Sensitive Compartmented Information (SCI)**: SCI must be transmitted via approved methods. Prior to transmitting SCI, contact the DARPA Special Security Office (SSO) at 703-248-7213 for instructions.

**Proprietary Data**: All proposals containing proprietary data should have the cover page and each page containing proprietary data clearly marked as containing proprietary data. It is the Proposer's responsibility to clearly define to the Government what is considered proprietary data.

Security classification guidance via a DD Form 254 will not be provided at this time since DARPA is soliciting ideas only. After reviewing the incoming proposals, if a determination is made that the award instrument may result in access to classified information a DD Form 254 will be issued and attached as part of the award.

Proposers must have existing and in-place prior to execution of an award, approved capabilities (personnel and facilities) to perform research and development at the classification level they propose. It is the policy of DARPA to treat all proposals as competitive information, and to disclose their contents only for the purpose of evaluation. Proposals will not be returned. The original of each proposal received will be retained at DARPA and all other non-required copies destroyed. A certification of destruction may be requested, provided the formal request is received at this office within 5 days after unsuccessful notification.

## **2. Abstract and Proposal Information**

Proposers who choose to use abstracts are strongly encouraged to submit a proposal abstract in advance of a full proposal. This procedure is intended to minimize unnecessary effort in proposal preparation and review. The time and date for submission of proposal abstracts is specified in Section C below. DARPA will acknowledge receipt of the submission and assign a control number that should be used in all further correspondence regarding the proposal abstract.

DARPA will respond to proposal abstracts with a statement as to whether DARPA is interested in the idea. DARPA will attempt to reply to proposal abstracts via letter within thirty (30) calendar days of receipt. Should a proposer be discouraged from submitting a full proposal, the letter will contain feedback for the proposer regarding the rationale for the decision not to recommend a full proposal be submitted. Proposal abstracts will be reviewed in the order they are received. Early submissions of proposal abstracts and full proposals are strongly encouraged because selections may be made at any time during the period of solicitation. Regardless of DARPA's response to a proposal abstract, proposers may submit a full proposal. DARPA will review all full proposals submitted using the published evaluation criteria and without regard to any comments resulting from the review of a proposal abstract.

Proposers are required to submit full proposals by the time and date specified in the BAA in order to be considered during the initial round of selections. DARPA may evaluate proposals received after this date for a period up to one year from date of posting on FedBizOpps and Grants.gov.

The typical proposal should express a consolidated effort in support of one or more related technical concepts or ideas. Disjointed efforts should not be included into a single proposal.

Restrictive notices notwithstanding, proposals may be handled, for administrative purposes only, by a support contractor. This support contractor is prohibited from competition in DARPA technical research and is bound by appropriate nondisclosure requirements. Proposals and proposed abstracts may not be submitted by fax or e-mail; any so sent will be disregarded.

Proposals not meeting the format described in the BAA may not be reviewed.

For Proposers Posting to Grants.Gov:

Proposers may elect to use the Grants.gov APPLY function if the applicant is seeking a grant or cooperative agreement. The APPLY function replaces the proposal submission process that other proposers follow. The APPLY function does not affect the proposal content or format. The APPLY function is electronic; proposers do not submit paper proposals in addition to the Grants.gov APPLY electronic submission.

Proposers must complete the following steps before submitting proposals on Grants.gov (these steps are also detailed at [www.grants.gov/applicants/get\\_registered.jsp](http://www.grants.gov/applicants/get_registered.jsp)):

- Proposers must obtain a DUNS number
- Proposers must register their organization in the Central Contractor Registration (CCR) (<https://www.bpn.gov/CCRSearch/Search.aspx>)
- Proposers must obtain a user name and password with an E-Authentication provider
- Proposers must register the Authorized Organization Representative (AOR) in Grants.gov
- Proposers must have the organization's E-BIZ point of contact authorize the AOR to submit applications.

Grant or cooperative agreement proposals, in their entirety, may only be submitted to DARPA through Grants.gov. Grant or cooperative agreement proposals may not be submitted through any other means, including T-FIMS or other comparable systems.

For All:

All administrative correspondence and questions on this solicitation, including requests for information on how to submit a proposal abstract or full proposal to this BAA, should be directed to one of the administrative addresses below; e-mail or fax is preferred. (electronic mail: [DARPA-BAA-09-26@darpa.mil](mailto:DARPA-BAA-09-26@darpa.mil), fax: 703-496-2069, DARPA/MTO.) DARPA intends to use electronic mail and fax for correspondence regarding DARPA-BAA-09-26. Proposals and proposal abstracts may not be submitted by fax or e-mail; any so sent will be disregarded. DARPA encourages use of the Internet for retrieving the BAA and any other related information that may subsequently be provided.

For Proposers Submitting proposals through T-FIMS:

Proposals sent in response to DARPA-BAA-09-26 must be submitted through T-FIMS. See <https://www.tfims.darpa.mil/baa/> for more information on how to request an account, upload proposals, and use the T-FIMS tool. Because proposers using T-FIMS may encounter heavy traffic on the web server, and T-FIMS requires a registration and certificate installation for all proposers, proposers should not wait until the day the proposal is due to create an account in T-FIMS and submit the proposal. All proposers using T-FIMS must also encrypt the proposal, as per the instructions below.

All proposals submitted electronically through T-FIMS must be encrypted using Winzip or PKZip with 256-bit AES encryption. Only one zipped/encrypted file will be accepted per proposal and proposals not zipped/encrypted will be rejected by DARPA. An encryption password form must be completed and emailed to ([DARPA-BAA-09-26@darpa.mil](mailto:DARPA-BAA-09-26@darpa.mil)) at the time of proposal submission. See <https://www.tfims.darpa.mil/baa/> for the encryption password form.

Note the word "PASSWORD" must appear in the subject line of the above email and there are minimum security requirements for establishing the encryption password.

Failure to provide the encryption password may result in the proposal not being evaluated. For further information and instructions on how to zip and encrypt proposal files, see <https://www.tfims.darpa.mil/baa/>.

## 2. Proposal Abstract Format

Proposal abstracts are encouraged in advance of full proposals in order to provide potential proposers with a rapid response to minimize unnecessary effort. Proposal abstracts should follow the same general format as described for Volume I under PROPOSAL FORMAT (see below), but include ONLY Sections I and II. The cover sheet should be clearly marked “PROPOSAL ABSTRACT” and the total length should not exceed {10} number of pages, excluding cover page and official transmittal letter. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller font may be used for figures, tables and charts. The page limitation for proposal abstracts includes all figures, tables, and charts. No formal transmittal letter is required. All proposal abstracts must be written in English.

## 3. Full Proposal Format

All full proposals must be in the format given below. Nonconforming proposals may be rejected without review. Proposals shall consist of two volumes. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller font may be used for figures, tables and charts. The page limitation for full proposals includes all figures, tables, and charts. Volume I, Technical and Management Proposal, may include an attached bibliography of relevant technical papers or research notes (published and unpublished) which document the technical ideas and approach upon which the proposal is based. Copies of not more than three (3) relevant papers can be included with the submission. The bibliography and attached papers are not included in the page counts given below. The submission of other supporting materials along with the proposals is strongly discouraged and will not be considered for review. Except for the attached bibliography and Section I, **Volume I shall not exceed {50} number pages**. Maximum page lengths for each section are shown in braces { } below. All full proposals must be written in English. **Volume I and Volume II must be submitted as separate files.**

## 4. Volume I, Technical and Management Proposal

### Section I. Administrative

A. {1} Cover sheet to include:

- (1) BAA number
- (2) Technical area
- (3) Lead Organization Submitting proposal
- (4) Type of business, selected among the following categories: “LARGE BUSINESS”, “SMALL DISADVANTAGED BUSINESS”, “OTHER SMALL BUSINESS”, “HBCU”, “MI”, “OTHER EDUCATIONAL”, OR “OTHER NONPROFIT”
- (5) Contractor’s reference number (if any)

- (6) Other team members (if applicable) and type of business for each
  - (7) Proposal title
  - (8) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)
  - (9) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available), total funds requested from DARPA, and the amount of cost share (if any)
- AND
- (10) Date proposal was submitted.
- B. Official transmittal letter.

## Section II. Summary of Proposal

- A. {1} Innovative claims for the proposed research. This section is the centerpiece of the proposal and should succinctly describe the uniqueness and benefits of the proposed approach relative to the current state-of-art alternate approaches.
- B. {1} Deliverables associated with the proposed research and the plans and capability to accomplish technology transition and commercialization. Include in this section all proprietary claims to the results, prototypes, intellectual property, or systems supporting and/or necessary for the use of the research, results, and/or prototype. If there are not proprietary claims, this should be stated. For forms to be completed regarding intellectual property, see Section VIII. There will be no page limit for the listed forms.
- C. {1} Cost, schedule and payable milestones for the proposed research, including estimates of cost for each task in each year of the effort delineated by the prime and major subcontractors, total cost and company cost share, if applicable. **Note: Measurable critical milestones should occur every at the end of each Phase of the program after start of effort.** These payable milestones should enable and support a go/no go decision for the next part of the effort. Do not include proprietary information with the milestones. Additional interim non-critical management milestones are also highly encouraged at a regular interval.
- D. {1} Technical rationale, technical approach, and constructive plan for accomplishment of technical goals in support of innovative claims and deliverable production. (In the full proposal, this section should be supplemented by a more detailed plan in Section III.)
- E. {1} General discussion of other research in this area.
- F. {1} A clearly defined organization chart for the program team which includes, as applicable: (1) the programmatic relationship of team member; (2) the unique capabilities of team members; (3) the task of responsibilities of team members; (4) the teaming strategy among the team members; and (5) the key personnel along with the amount of effort to be expended by each person during each year.

### Section III. Detailed Proposal Information

- A. {20} Technical Rationale and Approach. Detailed technical rationale and approach enhancing that of Section II. A concise section outlining the scientific and technical challenges, unique approaches, and potential anticipated technical solutions to the challenges that will be addressed. This section should demonstrate that the proposer has a clear understanding of the state-of-the-art; and should provide sufficient technical details so as to permit complete evaluation of the feasibility of the idea. Additionally, comparison with other ongoing research shall be provided indicating advantages and disadvantages of the proposed effort.
- B. {8} Program Plan & Risk Assessment. Detailed program plan and risk assessment enhancing that of Section II. A narrative explaining the explicit timelines, milestone achievements, and quantitative program metrics (to include proposer defined metrics, if applicable) by which progress toward the goals can be evaluated. The proposed period of performance of the overall program, and each program phase, should be clearly stated. The narrative plan should include a specific test plan detailing how all program metrics will be accurately measured. All program metrics must be associated with demonstrable, quantitative measures of performance, and should be summarized in a single table. Proposals should clearly explain the technical approach(es) that will be employed to meet or exceed each program metric and provide ample justification as to why the approach(es) is/are feasible. This section should also identify major technical risk elements specific to the proposed approach, estimate the risk magnitude for each such element, and describe specific plans to mitigate risk. **All program metrics should be described/discussed in detail so reviewers can assess risks associated with meeting them. Measurable critical milestones should occur at the end of every phase.** These critical technical milestones should enable and support a go/no go decision for the next part of the effort. Additional interim, non-critical technical milestones are also highly encouraged at regular intervals.
- C. {6} Statement of Work (SOW) - In plain English, clearly define the technical tasks/subtasks to be performed, their durations, and dependencies amongst them. The SOW **must not** include proprietary information. The SOW **must** be developed so that each phase of the program is separately defined. The SOW **must** include, for each phase, a table defining the program metrics to be achieved. For each task/subtask, provide:
- A general description of the objective (for each defined task/activity);
  - A detailed description of the approach to be taken to accomplish each defined task/activity);
  - Identification of the primary organization responsible for task execution (prime, sub, team member, by name, etc.);
  - The exit criteria for each task/activity - a product, event or milestone that defines its completion.
  - Define all deliverables (reporting, data, reports, hardware, software, etc.) to be provided to the Government.

- D. {5} Teaming and Management Plan. A clearly defined organization chart for the program team which includes the programmatic relationship and a summary of each members roles and responsibilities. Additionally, a narrative discussing (1) the proposers teaming strategy/rationale; (2) the specific roles and responsibilities of the team members; (3) the unique capabilities of the team members; and (4) the proposers team management approach.
- E. {5} Capabilities. A section describing relevant prior work, the background, qualifications and relevant experience of team member organizations (prime and sub) and key individuals to be assigned to the program, and the facilities and equipment to be utilized. Please do not attach supporting material (CDs, movies, etc.) to the proposal, except as noted in Section IV below.
- F. {5} Technology Transition & Business Plan. A description of the results, products, transferable technology, and expected technology transfer path enhancing that of Section II. B. See also Section VIII “Intellectual Property.”
- G. {1} Cost schedules and Payable Milestones, if proposed, for the proposed research including estimates of cost for each task in each phase and year of the effort delineated by the primes and major subcontractors, total cost, and any company cost share. Payable milestones (descriptions, exit criteria, etc.), if proposed, must not include proprietary information. Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each.
- H. {3} Summary Slide(s). PowerPoint-type slide (s) (i.e., landscape formatted for presentation) that succinctly highlights the major aspects of the proposal, including all program metrics (including proposer defined metrics, if applicable), in a manner suitable for presentation to DARPA management.

#### Section IV. Additional Information

A brief bibliography of relevant technical papers and research notes (published and unpublished) which document the technical ideas upon which the proposal is based. Copies of not more than three (3) relevant papers can be included in the submission.

### **5. Volume II, Cost Proposal – {No Page Limit}**

Cover sheet to include:

- (1) BAA number;
- (2) Technical area;
- (3) Lead Organization Submitting proposal;
- (4) Type of business, selected among the following categories: “LARGE BUSINESS”, “SMALL DISADVANTAGED BUSINESS”, “OTHER SMALL BUSINESS”, “HBCU”, “MI”, “OTHER EDUCATIONAL”, OR “OTHER NONPROFIT”;
- (5) Contractor’s reference number (if any);
- (6) Other team members (if applicable) and type of business for each;
- (7) Proposal title;

- (8) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available);
- (9) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), and electronic mail (if available);
- (10) Award instrument requested: cost-plus-fixed-fee (CPFF), cost-contract—no fee, cost sharing contract – no fee, or other type of procurement contract (*specify*), grant, cooperative agreement, or other transaction;
- (11) Place(s) and period(s) of performance;
- (12) Total proposed cost separated by basic award and option(s) (if any);
- (13) Name, address, and telephone number of the proposer’s cognizant Defense Contract Management Agency (DCMA) administration office (*if known*);
- (14) Name, address, and telephone number of the proposer’s cognizant Defense Contract Audit Agency (DCAA) audit office (*if known*);
- (15) Date proposal was prepared;
- (16) DUNS number;
- (17) TIN number; and
- (18) Cage Code;
- (19) Subcontractor Information; and
- (20) Proposal validity period.

The proposers, to include eligible FFRDC’s, cost volume shall provide cost and pricing information, or other than cost or pricing information if the total price is under \$650,000, in sufficient detail to substantiate the program price proposed (e.g., realism and reasonableness). In doing so, the proposer shall provide a detailed cost breakdown by phase, task and month. The breakdown shall include, at a minimum, the following major cost items: direct labor (labor categories and labor hours per category); subcontracts (by subcontractor); material/equipment; other direct costs (travel, computer usage fee’s, etc.), and indirect charges (rates and factors such as Overhead, G&A, Fringe Benefits, etc.). Proposers are encouraged to provide the aforementioned cost breakdown as an editable MS Excel spreadsheet, inclusive of calculations formulae, with tabs (material, travel, ODC’s) provided as necessary. Additionally, the proposer shall provide (1) a summary of total program costs by phase and task, (2) an itemization of major subcontracts, (3) a priced Bill-of-Materials (BOM) clearly identifying, for each item proposed, the source of the unit price (i.e., vendor quote, engineering estimate, etc.) and the type of property (i.e., material, equipment, special test equipment, plant equipment, information technology (IT)<sup>5</sup>, etc.); (4) the source, nature, and amount of any industry cost-sharing; and (5)

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• <sup>5</sup> IT is defined as “any equipment, or interconnected system(s) or subsystem(s) of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the agency. (a) For purposes of this definition, equipment is used by an agency if the equipment is used by the agency directly or is used by a contractor under a contract with the agency which – (1) Requires the use of such equipment; or (2) Requires the use, to a significant extent, or such equipment in the performance of a service or the furnishing of a product. (b) The term “information technology” includes computers, ancillary, software, firmware and similar procedures, services (including support services), and related resources. (c) The term “information technology” does not include – (1) Any equipment

identification of pricing assumptions of which may require incorporation into the resulting award instrument (e.g., use of Government Furnished Property/Facilities/Information, access to Government Subject Matter Expert/s, etc.). Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each.

The proposer shall provide a detailed description of the methods used to estimate costs, to include, at a minimum: 1) substantiation of all rates and factors, and 2) labor and material estimates supported by a narrative basis-of-estimate (BOE) providing sufficient detail to substantiate cost estimates. The prime contractor is responsible for compiling and providing, as part of its proposal submission to the Government, subcontractor proposals prepared at the same level of detail as that required of the prime. Subcontractor proposals include Interdivisional Work Transfer Agreements (ITWA) or similar arrangements. If seeking a procurement contract, the prime contractor shall provide a cost reasonableness analysis of proposed subcontractor prices. Such analysis shall indicate the extent to which the prime contractor has negotiated subcontract prices. All proprietary subcontractor proposal documentation which cannot be uploaded to TFIMS as part of the proposers submission, shall be made immediately available to the Government, upon request, under separate cover (i.e., mail, electronic/email, etc.), either by the Proposer or by the subcontractor organization – this does not relieve the proposer from the requirement to include, as part of their TFIMS submission, subcontract proposals that do not include proprietary pricing information (rates, factors, etc.).

If seeking a procurement contract and items of Contractor Acquired Property are proposed, exclusive of material, the proposer shall clearly demonstrate that the inclusion of such items as Government Property is in keeping with the requirements of FAR Part 45.102. For IT purchases, all proposers shall include a letter stating why the proposer cannot provide the requested resources from its own funding.

*NOTE: “cost or pricing data” as defined in FAR Subpart 15.4 shall be required if the proposer is seeking a procurement contract award of \$650,000 or greater unless the proposer requests an exception from the requirement to submit cost or pricing data. “Cost or pricing data” are not required if the proposer proposes an award instrument other than a procurement contract (e.g., a grant, cooperative agreement, or other transaction.) Those proposing a grant or cooperative agreement may follow/use the application instructions/form templates (i.e., DARPA BAA Form Package) provided as part of the BAA posting to grants.gov; however, the costing details requested above should be provided to the maximum extent possible.*

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that is acquired by a contractor incidental to a contract; or (2) Any equipment that contains imbedded information technology that is used as an integral part of the product, but the principal function of which is not the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. For example, HVAC (heating, ventilation, and air conditioning) equipment such as thermostats or temperature control devices, and medical equipment where information technology is integral to its operation, are not information technology.”

The Defense Appropriations Act caps indirect cost rates for any procurement contract, grant or agreement using 6.1 Basic Research Funding at 35% of the total cost of the award. Total costs include all bottom line costs. For grants/agreement awardees subject to cost principles in 2 CFR part 220 (Educational Institutions), indirect costs are all costs of a prime award that are Facilities and Administration costs. For grant/agreement awardees subject to the cost principles in 2 CFR part 225 (State, Local, and Indian Tribal Governments), 2 CFR par 230 (Non-profit Organizations) or 48 CFR part 23 (Federal Acquisition Regulation), indirect costs refer to any cost not directly identified with a single final cost objective, but identified with two or more final cost objectives or with at least one intermediate cost objective. The cost limitations do not flow down to subcontractors.

### **C. Submission Dates and Times**

#### **1. Proposal Abstract Date**

The proposal abstract must be submitted to DARPA via T-FIMS on or before 4:00 p.m., local time, May 15, 2009. Initial round proposal abstracts received after this time and date may not be reviewed.

#### **2. Full Proposal Date**

The full proposal must be submitted to DARPA via T-FIMS or Grants.gov on or before 4:00 p.m., local time at Arlington, VA, July 15, 2009, in order to be considered during the initial round of selections; however, proposals received after this deadline may be received and evaluated up to one year from date of posting. Full proposals submitted after the due date specified in the BAA or due date otherwise specified by DARPA after review of proposal abstracts may be selected contingent upon the availability of funds. Proposers are warned that the likelihood of funding is greatly reduced for proposals submitted after the initial round deadline.

DARPA will post a consolidated Question and Answer document (FAQ) on the MTO solicitation webpage up through July 2, 2009. In order to receive a response to your question/s they must be submitted to [BAA-09-26@darpa.mil](mailto:BAA-09-26@darpa.mil) by no later than June 25, 2009.

DARPA will acknowledge receipt of complete submissions via email and assign control numbers that should be used in all further correspondence regarding proposals.

Failure to comply with the submission procedures may result in the submission not being evaluated.

#### **D. Intergovernmental Review**

Not Applicable.

#### **E. Funding Restrictions**

Not Applicable.

### **V. APPLICATION REVIEW INFORMATION**

#### **A. Evaluation Criteria**

Evaluation of proposals will be accomplished through a scientific/technical review of each proposal using the following criteria: (a) Overall Scientific and Technical Merit; (b) Potential Contribution and Relevance to the DARPA Mission; (c) Proposer's Capabilities and Related Experience; (d) Plans and Capability to Accomplish Technology Transition; (e) Cost Realism; and (f) Realism of Proposed Schedule. Criteria (a) and (b) are of equal importance and are more important than Criteria (c). Criteria (c) is more important than Criteria (d). Criteria (d) is more important than Criteria (e). Criteria (e) and (f) are of equal importance. Criteria (e) and (f) are the least important.

Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons. The following are descriptions of the above listed criteria:

##### **(a) Overall Scientific and Technical Merit**

The proposed technical approach is feasible, achievable, complete and supported by a proposed technical team that 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 product 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. The feasibility and likelihood of the proposed approach for satisfying the program go/no-go metrics are explicitly described and clearly substantiated. The proposal reflects a mature and quantitative understanding of the program go/no-go metrics, the statistical confidence with which they may be measured and, if proposer-defined go/no-go metrics are proposed, their relationship to the concept of operations that will result from successful performance in the program.

##### **(b) Potential Contribution and Relevance to the DARPA Mission**

The potential contributions of the proposed effort with relevance to the national technology base will be evaluated. Specifically, DARPA's mission is to maintain the technological superiority of the U.S. military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their military use.

**(c) Proposer’s Capabilities and/or Related Experience**

The proposer's prior experience in similar efforts must clearly demonstrate an ability to deliver products that meet the proposed technical performance within the proposed budget and schedule. The proposed team has the expertise to manage the cost and schedule. Similar efforts completed/ongoing by the proposer in this area are fully described including identification of other Government sponsors.

**(d) Plans and Capability to Accomplish Technology Transition**

The capability to transition the technology to the research, industrial, and operational military communities in such a way as to enhance U.S. defense, and the extent to which intellectual property rights limitations creates a barrier to technology transition.

**(e) Cost Realism**

The objective of this criterion is to establish that the proposed costs are realistic for the technical and management approach offered, as well as to determine the proposer’s practical understanding of the effort. This will be principally measured by cost per labor-hour and number of labor-hours proposed. The evaluation criterion recognize 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. Cost reduction approaches that will be received favorably include innovative management concepts that maximize direct funding for technology and limit diversion of funds into overhead.

**(f) Realism of Proposed Schedule**

The proposer’s abilities to aggressively pursue performance metrics in the shortest timeframe and to accurately account for that timeframe will be evaluated, as well as proposer’s ability to understand, identify, and mitigate any potential risk in schedule.

After selection and before award the contracting officer will negotiate cost/price reasonableness.

Award(s) will be made to proposers whose proposals are determined to be the most advantageous to the Government, all factors considered, including the potential contributions of the proposed work to the overall research program and the availability of funding for the effort. Award(s) may be made to any proposer(s) whose proposal(s) is determined selectable regardless of its overall rating.

NOTE: PROPOSERS ARE CAUTIONED THAT EVALUATION RATINGS MAY BE LOWERED AND/OR PROPOSALS REJECTED IF SUBMITTAL INSTRUCTIONS ARE NOT FOLLOWED.

## **B. Review and Recommendation Process**

It is the policy of DARPA to ensure impartial, equitable, comprehensive proposal evaluations and to select the source (or sources) whose offer meets the Government's technical, policy, and programmatic goals. Pursuant to FAR 35.016, the primary basis for selecting proposals for acceptance shall be technical, importance to agency programs, and fund availability. In order to provide the desired evaluation, qualified Government personnel will conduct reviews and (if necessary) convene panels of experts in the appropriate areas.

Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons. For evaluation purposes, a proposal is the document described in "Proposal Information", Section IV.B.. Other supporting or background materials submitted with the proposal will be considered for the reviewer's convenience only and not considered as part of the proposal.

Restrictive notices notwithstanding, proposals may be handled for administrative purposes by support contractors. These support contractors are prohibited from competition in DARPA technical research and are bound by appropriate non-disclosure requirements.

Subject to the restrictions set forth in FAR 37.203(d), input on technical aspects of the proposals may be solicited by DARPA from non-Government consultants /experts who are strictly bound by the appropriate non-disclosure requirements.

It is the policy of DARPA to treat all proposals as competitive information and to disclose their contents only for the purpose of evaluation. No proposals will be returned. After proposals have been evaluated and selections made, the original of each proposal received will be retained at DARPA and all other copies will be destroyed.

## **VI. AWARD ADMINISTRATION INFORMATION**

### **A. Award Notices**

As soon as the evaluation of a proposal is complete, the proposer will be notified that 1) the proposal has been selected for funding pending contract negotiations, or 2) the proposal has not been selected. These official notifications will be sent via U.S. mail and/or electronic mail to the Technical POC identified on the proposal coversheet.

### **B. Administrative and National Policy Requirements**

#### **1. Meeting and Travel Requirements**

There will be a program kickoff meeting and all key participants are required to attend. Performers should also anticipate periodic site visits at the Program Manager's discretion.

## 2. Human Use

All research involving human subjects, to include use of human biological specimens and human data, selected for funding must comply with the federal regulations for human subject protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, *Protection of Human Subjects* (<http://www.dtic.mil/biosys/downloads/32cfr219.pdf>), and DoD Directive 3216.02, *Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research* (<http://www.dtic.mil/whs/directives/corres/html2/d32162x.htm>).

Institutions awarded funding for research involving human subjects must provide documentation of a current Assurance of Compliance with Federal regulations for human subject protection, for example a Department of Health and Human Services, Office of Human Research Protection Federal Wide Assurance (<http://www.hhs.gov/ohrp>). All institutions engaged in human subject research, to include subcontractors, must also have a valid Assurance. In addition, personnel involved in human subjects research must provide documentation of completing appropriate training for the protection of human subjects.

For all proposed research that will involve human subjects in the first year or phase of the project, the institution must provide evidence of or a plan for review by an Institutional Review Board (IRB) upon final proposal submission to DARPA. The IRB conducting the review must be the IRB identified on the institution's Assurance. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and benefits of study participation, recruitment and consent process, data collection, and data analysis. Consult the designated IRB for guidance on writing the protocol. The informed consent document must comply with federal regulations (32 CFR 219.116). A valid Assurance along with evidence of appropriate training all investigators should all accompany the protocol for review by the IRB.

In addition to a local IRB approval, a headquarters-level human subjects regulatory review and approval is required for all research conducted or supported by the DoD. The Army, Navy, or Air Force office responsible for managing the award can provide guidance and information about their component's headquarters-level review process. Note that confirmation of a current Assurance and appropriate human subjects protection training is required before headquarters-level approval can be issued.

The amount of time required to complete the IRB review/approval process may vary depending on the complexity of the research and/or the level of risk to study participants. Ample time should be allotted to complete the approval process. The IRB approval process can last between one to three months, followed by a DoD review that could last between three to six months. No DoD/DARPA funding can be used towards human subjects research until ALL approvals are granted.

### **3. Animal Use**

Any Recipient performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling, and use in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Laboratory Animal Welfare Act of 1966, as amended, (7 U.S.C. 2131-2159); (ii) the guidelines described in National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals"; (iii) DoD Directive 3216.01, "Use of Laboratory Animals in DoD Program."

For submissions containing animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the PHS Policy on Humane Care and Use of Laboratory Animals, available at <http://grants.nih.gov/grants/olaw/olaw.htm>.

All Recipients must receive approval by a DoD certified veterinarian, in addition to an IACUC approval. No animal studies may be conducted using DoD/DARPA funding until the USAMRMC Animal Care and Use Review Office (ACURO) or other appropriate DoD veterinary office(s) grant approval. As a part of this secondary review process, the Recipient will be required to complete and submit an ACURO Animal Use Appendix, which may be found at <https://mrmc.amedd.army.mil/AnimalAppendix.asp>

### **4. Publication Approval**

It is the policy of the Department of Defense for products of fundamental research to remain unrestricted to the maximum extent possible. Contracted fundamental research:

Includes research performed under grants and contracts that are (a) Basic Research"), whether performed by universities or industry or (b) applies research and performed on-campus at a university. The research shall not be considered fundamental in those rare and exception circumstances where the applied research effort presents a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense, and where agreement on restrictions have been recorded in the contract or grant.

It is anticipated that the performance of research resulting from the BAA is expected to be fundamental research.

Proposers are advised if they propose grants or cooperative agreements, DARPA may elect to award other award instruments. DARPA will make this election if it determines that the research resulting from the proposed program 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.

The following provision will be incorporated into any resultant non-fundamental research procurement contract or other transaction:

There shall be no dissemination or publication, except within and between the Contractor and any subcontractors, of information developed under this contract or contained in the reports to be furnished pursuant to this contract without prior written approval of the DARPA Technical Information Officer (DARPA/TIO). All technical reports will be given proper review by appropriate authority to determine which Distribution Statement is to be applied prior to the initial distribution of these reports by the Contractor. Papers resulting from unclassified contracted fundamental research are exempt from prepublication controls and this review requirement, pursuant to DoD Instruction 5230.27 dated October 6, 1987.

When submitting material for written approval for open publication, the Contractor/Awardee must submit a request for public release to the DARPA TIO and include the following information: 1) Document Information: document title, document author, short plain-language description of technology discussed in the material (approx. 30 words), number of pages (or minutes of video) and document type (briefing, report, abstract, article, or paper); 2) Event Information: event type (conference, principle investigator meeting, article or paper), event date, desired date for DARPA's approval; 3) DARPA Sponsor: DARPA Program Manager, DARPA office, and contract number; and 4) Contractor/Awardee's Information: POC name, e-mail and phone. Allow four weeks for processing; due dates under four weeks require a justification. Unusual electronic file formats may require additional processing time. Requests can be sent either via e-mail to [tio@darpa.mil](mailto:tio@darpa.mil) or via 3701 North Fairfax Drive, Arlington VA 22203-1714, telephone (571) 218-4235. Refer to [www.darpa.mil/tio](http://www.darpa.mil/tio) for information about DARPA's public release process.

## **5. Export Control**

Should this project develop beyond fundamental research (basic and applied research ordinarily published and shared broadly within the scientific community) with military or dual-use applications the following apply:

(1) The Contractor shall comply with all U. S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the Contractor shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

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

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

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

## **6. Subcontracting**

Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. 637(d)), it is the policy of the Government to enable small business and small disadvantaged business concerns to be considered fairly as subcontractors to contractors performing work or rendering services as prime contractors or subcontractors under Government contracts, and to assure that prime contractors and subcontractors carry out this policy. Each proposer who submits a contract proposal and includes subcontractors is required to submit a subcontracting plan in accordance with FAR 19.702(a) (1) and (2) should do so with their proposal. The plan format is outlined in FAR 19.704.

## **C. Reporting**

The number and types of reports will be specified in the award document, but will include as a minimum quarterly financial status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed on before award. Reports and briefing material will also be required as appropriate to document progress in accomplishing program metrics. A Final Report that summarizes the project and tasks will be required at the conclusion of the performance period for the award, notwithstanding the fact that the research may be continued under a follow-on vehicle.

## **D. Electronic Systems**

### **1. Central Contractor Registration (CCR)**

Selected proposers not already registered in the Central Contractor Registry (CCR) will be required to register in CCR prior to any award under this BAA. Information on CCR registration is available at <http://www.ccr.gov>.

### **2. Representations and Certifications**

In accordance with FAR 4.1201, prospective proposers shall complete electronic annual representations and certifications at <http://orca.bpn.gov>.

### **3. Wide Area Work Flow (WAWF)**

Unless using another approved electronic invoicing system, performers will be required to submit invoices for payment directly via the Internet/WAWF at <http://wawf.eb.mil>. Registration to WAWF will be required prior to any award under this BAA.

### **4. i-Edison**

The award document for each proposal selected and funding will contain a mandatory requirement for patent reports and notifications to be submitted electronically through i-Edison (<http://s-edison.info.nih.gov/iEdison>).

## **VII. AGENCY CONTACTS**

Administrative, technical or contractual questions should be sent via e-mail to [DARPA-BAA-09-26@darpa.mil](mailto:DARPA-BAA-09-26@darpa.mil). If e-mail is not available, fax questions to 703-469-2069, Attention: DARPA-BAA-09-26. All requests must include the name, email address, and phone number of a point of contact.

#### Points of Contact

The technical POC for this effort is Joe Mangano

DARPA/MTO

ATTN: DARPA-BAA-09-26

3701 North Fairfax Drive

Arlington, VA 22203-1714

FAX: 703-469-2069

EMAIL: [DARPA-BAA-09-26@darpa.mil](mailto:DARPA-BAA-09-26@darpa.mil)

## **VIII. OTHER INFORMATION**

### **A. Intellectual Property**

#### **1. Procurement Contract Proposers**

##### **a. Noncommercial Items (Technical Data and Computer Software)**

Proposers responding to this BAA requesting a procurement contract to be issued under the FAR/DFARS shall identify all noncommercial technical data and noncommercial computer software that it plans to generate, develop, and/or deliver under any proposed award instrument in which the Government will acquire less than unlimited rights, and to assert specific restrictions on those deliverables. Proposers shall follow the format under DFARS 252.227-7017 for this stated purpose. If mixed funding is anticipated in the development of noncommercial technical data and noncommercial computer software generated, developed, and/or delivered under any award instrument, then proposers should identify the data and software in question, as subject to Government Purpose Rights (GPR) and propose a restriction period if other than the period stipulated at

DFARS 252.227-7013 Rights in Technical Data - Noncommercial Items and DFARS 252.227-7014 Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation. Proposers are advised that the Government will use the list during the evaluation process to evaluate the impact of any identified restrictions and may request additional information from the proposer, as may be necessary, to evaluate the proposer’s assertions. If no restrictions are intended, then the proposer should state “NONE.” It is noted an assertion of “NONE” indicates that the Government has “unlimited rights” to all noncommercial technical data and noncommercial computer software delivered under the award instrument, in accordance with the DFARS provisions cited above. Failure to provide full information may result in a determination that the proposal is not compliant with the BAA – resulting in nonselectability of the proposal.

A sample list for complying with this request is as follows:

NONCOMMERCIAL				
Technical Data Computer Software To be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

**b. Commercial Items (Technical Data and Computer Software)**

Proposers responding to this BAA requesting a procurement contract to be issued under the FAR/DFARS shall identify all commercial technical data and commercial computer software that may be embedded in any noncommercial deliverables contemplated under the research effort, along with any applicable restrictions on the Government’s use of such commercial technical data and/or commercial computer software. The Government may use the list during the evaluation process to evaluate the impact of any identified restrictions and may request additional information from the proposer, as may be necessary, to evaluate the proposer’s assertions. If no restrictions are intended, then the proposer should state “NONE.” Failure to provide full information may result in a determination that the proposal is not compliant with the BAA – resulting in nonselectability of the proposal.

A sample list for complying with this request is as follows:

COMMERCIAL				
Technical Data Computer Software To be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

## **2. Non-Procurement Contract Proposers – Noncommercial and Commercial Items (Technical Data and Computer Software)**

Proposers responding to this BAA requesting a Technology Investment Agreement, or Other Transaction for Prototype shall follow the applicable rules and regulations governing these various award instruments, but in all cases should appropriately identify any potential restrictions on the Government's use of any Intellectual Property contemplated under those award instruments in question. This includes both Noncommercial Items and Commercial Items. Although not required, proposers may use a format similar to that described in Paragraphs 1.a and 1.b above. The Government will use the list during the evaluation process to evaluate the impact of any identified restrictions, and may request additional information from the proposer, as may be necessary, to evaluate the proposer's assertions. If no restrictions are intended, then the proposer should state "NONE." Failure to provide full information may result in a determination that the proposal is not compliant with the BAA – resulting in nonselectability of the proposal.

## **3. All Proposers – Patents**

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

## **4. All Proposers – Intellectual Property Representations**

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