Broad Agency Announcement

Extreme Optics and Imaging (EXTREME)

Defense Sciences Office

DARPA-BAA-16-58

August 24, 2016

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PART I: OVERVIEW INFORMATION

- **Federal Agency Name:** Defense Advanced Research Projects Agency (DARPA), Defense Sciences Office (DSO)

- **Funding Opportunity Title:** Extreme Optics and Imaging (EXTREME)

- **Announcement Type:** Initial Announcement

- **Funding Opportunity Number:** DARPA-BAA-16-58

- **Catalog of Federal Domestic Assistance (CFDA) Number(s):** 12.910 Research and Technology Development

- **Dates** (All times listed herein are Eastern Time.)
  - Posting Date: August 24, 2016.
  - Proposers Day: September 1, 2016. See Section VIII.C.
  - Abstract Due Date: September 9, 2016, 4:00 p.m.
  - FAQ Submission Deadline: October 18, 2016, 4:00 p.m. See Section VIII.A.
  - Full Proposal Due Date: October 25, 2016, 4:00 p.m.
- **Anticipated Individual Awards:** DARPA anticipates multiple awards distributed across all Technical Areas.

- **Types of Instruments that May be Awarded:** Procurement contracts, cooperative agreements or other transactions

- **Agency contacts**

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  - **DARPA/DSO Solicitation Website:** http://www.darpa.mil/work-with-us/opportunities

- **Teaming Information:** See Section VIII.B for information on teaming opportunities.

- **Frequently Asked Questions (FAQ):** FAQs for this solicitation may be viewed on the DSO Solicitation Website. See Section VIII.A for further information.

PART II: FULL TEXT OF ANNOUNCEMENT

I. Funding Opportunity Description

This Broad Agency Announcement (BAA) is being issued, and any resultant selection will be made, using procedures under Federal Acquisition Regulation (FAR) 35.016 and the Department of Defense Grant and Agreement Regulatory System (DoDGARS) Part 22 for Grants and Cooperative Agreements. Any negotiations and/or awards will use procedures under FAR 15.4, Contract Pricing, as specified in the BAA (including DoDGARS Part 22 for Grants and Cooperative Agreements). Any amendments to this BAA will be posted to the Federal Business Opportunities (FBO) website (http://www.fbo.gov/) and, as applicable, the Grants.gov website (http://www.grants.gov/).

Introduction

The Defense Sciences Office at the Defense Advanced Research Projects Agency (DARPA) is soliciting innovative research proposals in the area of optical systems capable of extreme performance and/or capabilities, which utilize Engineered Optical Materials (EnMats). Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, and/or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

Background

Modern day optical systems are capable of doing more than ever before with less Size, Weight, and Power (SWaP). With the rare exception, however, these optical systems adhere to age-old architectures that drive practical solutions towards unsustainable complexity under ever-increasing performance requirements For example, high resolution imaging systems may require dozens of large-area elements in order to achieve the desired spatial resolution requirements, making their design, manufacturing, assembly and alignment very difficult, and rendering optics and opto-mechanics heavy and sensitive to mechanical and thermal perturbations.

Current optical architectures, whether a single lens or a complete system, have been constrained in form and function by a set of "laws", rules, assumptions, and practices which can be considered to be pillars of optical design. For the purpose of this solicitation, examples of these pillars include, but are not limited to the following:

- "Laws" of Reflection and Refraction are immutable
- Optical functionality is directly tied to element geometry
- Elements are mono-functional
- The vast majority of optical elements are static (e.g., fixed properties)
- Optical "work" is confined to surfaces (volumetric control is largely ignored)
- Light propagation is primarily sequential
- Scattering of light degrades performance

Such pillars originated in early days of optics when a limited set of optical materials was available, and they persist today even with the promise of new materials, architectures and

optical properties. Under this solicitation, we will refer to these as "conventional materials", which are defined as having fixed optical properties in space (spatially homogenous) and time, with limited variation in regards to optical plenoptic function variables (e.g., angle, wavelength, polarization, etc.). Complementary to these conventional materials is the emerging field of EnMats that derive their optical properties from their structure. EnMats are broadly defined to include, but are not limited to, metamaterials (both metallic and dielectric), scattering surfaces and volumes, holographic structures, and diffractive elements.

The EXTREME program aims to reinvent optical components, devices, systems, architectures, and design tools in the context of EnMats. Although some early EnMats (volume holograms, and diffractive/refractive hybrid devices) have existed for decades, the utility/capability of such structures has not been fully realized due to limited material properties and very limited incorporation into modeling, design, and optimization environments. The potential of EnMats is beginning to be demonstrated, due in large part to recent advances in modeling and fabrication techniques. Early examples of EnMats have, under constrained conditions, broken free from the standard "laws" of Reflection and Refraction.[1,2] They have been used to design and build multifunctional elements[3,4,5] as well as volumetrically[6] and dynamically[7] control light. Volumetric EnMats are far less explored in comparison to surface-based EnMats, and represent a frontier challenge in this space, with huge potential for revolutionary breakthroughs. In addition, recent developments in modeling approaches[8] and concepts for classifying the building blocks of engineered materials[9,10] are providing new insights and design methodologies. It is imperative that a unified approach is developed that encompasses the fabrication, modeling and simulation environments, and overall design methodologies to guide development of optimal optical architectures incorporating EnMats.

Program Description

The goal of the EXTREME Program is to develop new optical architectures designed in concert with the maturation of practical EnMats (i.e., wide spectral bandwidth, low loss, etc.) to enable new functionality and/or vastly improve SWaP characteristics of traditional optical systems. If successful, the EXTREME program will open up a heretofore unexplored optical design space, redefining, if not completely breaking, trade-offs that are inherent to traditional optical design processes. Please note that DARPA is interested in the application of EnMats to novel optical architectures, and not on advancing any specific EnMat during this program. Specifically not of interest to EXTREME is conventional gradient refractive index (GRIN) optics.

1 N. Yu, et al., Science 334, 333–337 (2011).
2 S. Sun, et al., Nano Letters 12, 6223–6229 (2012).
3 T. Zentgraf, et al., Adv. Mater. 22, 2561–2564 (2010).
4 M. Khorasaninejad, et al., Nano Letters 16, 4595-4600 (2016).
5 S. Gupta, et al., arXiv:1412.7791 (2014).
6 T. Gerke et al., Nat. Photonics 4, (2010).
7 P. Iyer et al., ACS Photonics 2, 1077-1084 (2015).
8 N. Engheta, Science 317, 1698-1702 (2007).
9 C. Bingham et al., Opt. Express 16, 18565-18575 (2008).
10 S. Zhou, et al., Opt. Express 18, 6693–6702 (2010).

The EXTREME Program anticipates significant participation from communities such as EnMat design and fabrication; multiscale mathematical modeling, simulation, optimization; and optical system design. It is envisioned that these communities will need to work closely together, but for clarity, the important program outcomes are highlighted here along each community separately:

- EnMat design and fabrication:
  a) Scalable (in area) fabrication techniques that allow EnMats to be manufactured on large area[11] conformal/free-form surfaces
  b) Scalable (in volume) fabrication techniques that allow 3D EnMats to be manufactured over large volumes[12]
  c) Ability to design and fabricate EnMats with wide spectral coverage in one or more of the following optical bands: visible, near-infrared, short-wave infrared, mid-wave infrared, and long-wave infrared
  d) Ability to design and fabricate low loss EnMats with high efficiency and throughput
  e) EnMats with dynamic control of light which include, but are not limited to, variable optical properties, linear and nonlinear effects (e.g., gain), or control over material shape (e.g., bendable, expandable, etc.)
  f) Metrology techniques capable of accurately determining key optical properties over relevant length scales

- Multiscale mathematical modeling, simulation, and optimization:
  a) Multiscale modeling and simulation techniques that can potentially operate across 7 orders of magnitude of spatial scale
  b) Forward and inverse models for EnMat components, systems, and architectures that can efficiently and accurately compute far field scattering
  c) Ability to derive and/or optimize new shapes and geometries for the building blocks of EnMats (i.e., unit cells, dielectric or metal resonators, scattering centers, etc.)

- Optical system design and optimization:
  a) Design of imaging and non-imaging optical systems which utilize large spatial scale EnMat components (either solely EnMat components and/or hybrid-conventional EnMat are acceptable)
  b) Development of physics-based design principles (which include heuristics and rules of thumb) to guide the incorporation of large spatial scale EnMats into conventional optical systems
  c) Design and optimization environments, tailored to specific EnMat components and systems, in order to achieve next generation optical architectures (e.g., DARPA envisions optimization environments that natively build around refractive/reflective, diffractive, and/or scattering EnMats instead of incorporating the capability as an add-on or plug-in to existing tools)

[11] Typically on the order of square centimeters.
[12] Typically on the order of cubic centimeters.

DARPA expects close collaboration and teaming from the three communities described above (and potentially others), to develop novel system architectures with extreme capabilities that are based on EnMats. These new architectures are expected to achieve at least an **order of magnitude SWaP reduction** and/or **revolutionary performance improvement** over equivalent state-of-the-art (SOA) systems.

To achieve the goals of the EXTREME program described above, proposers will address an architectural challenge problem. The selected challenge problem will guide the EnMats development as well as the modeling and simulation development and is described in further detail below.

Program Structure

EXTREME is divided into two 24-month phases. Proposals must address both phases and should be structured with Phase I tasks/costs as the base effort and Phase II tasks/costs as an option. Phase I focuses on exploration and verification of newly designed EnMats with expanded capabilities on a small spatial scale. Phase I also includes the development of new multiscale modeling, simulation, and optimization tools. The goal of Phase I is to advance theoretical understanding and enhance the capabilities of EnMats so they can be used in practical optical systems. The goal of Phase II is to utilize Phase I concepts to design, fabricate, and demonstrate EnMat-based optical systems and architectures on a large spatial scale (order of centimeters, see Table 1). Additionally, Phase II work will continue to refine modeling and design environments.

EXTREME is divided into three technical areas (TAs). The first two TAs focus on EnMat development and incorporation into relevant optical systems. The third TA focuses on modeling, design, and optimization, providing novel tools and approaches to support work in TA1 and TA2. Proposers may apply to any and all TAs.

TA1: Modifying the Principles of Conventional Optics

In Phase I, TA1 performers will analyze the limits to which EnMats can modify conventional light propagation laws defined as the laws typically used within the optical design process. This includes, but is not limited to, the Law of Reflection, Snell's Law, and Fresnel refraction/reflection coefficients. Theories, concepts, and techniques will be developed to address current limitations of EnMats in terms of efficiency, wavelength, bandwidth, polarization, and working numerical aperture. DARPA expects proof-of-concept demonstrations on a small scale by the end of Phase I. A critical criterion for the Phase I to Phase II transition will be based on the feasibility of scaling EnMat size (>1 cm^2 clear aperture) to be compatible with practical optical devices. DARPA expects optical system architectures utilizing the modified laws afforded by these cm-scale EnMats to be designed, fabricated, and tested by the end of Phase II. Architectures developed in TA1 may be composed of fully EnMat or a hybrid system that also incorporates conventional components. Any EnMats capable of modifying conventional optical laws may be proposed.

Groups proposing to TA1 should note that they must include sufficient modeling, design, and optimization capabilities to accomplish their TA1 goals. While they will interact throughout the program with TA3 performers, they should not depend on them for accomplishing their proposed tasks.

TA2: Multifunctional Optics

During Phase I, TA2 performers will explore the limits and state-of-the-possible of multifunctional optical elements. Multiplexing of functionality may be achieved in a serial (i.e., stacks of surfaces performing a set of functions) or parallel manner (i.e., interleaved multiple functions performed simultaneously within a surface or volume). As an example, for the purposes of this solicitation, an imager is considered to perform a single function, a spectrometer is considered to perform a single function, a hyperspectral imager would be considered to perform two functions, and a compressive hyperspectral imager would be considered to perform three functions. DARPA is interested in multifunctional element(s) which could potentially replace an entire SOA system. Note that the quality of a given function is highly variable and dependent on the application (e.g., a singlet and lithographic system both image, but to vastly different degrees). Multifunctional elements developed under EXTREME are expected to be of an equivalent or better quality when evaluated against a comparable SOA system, should one exist.

Proposers are expected to develop theories to explore the limits and tradeoffs of multiplexing functions with respect to component area/volume and concepts for multifunctional EnMat devices. DARPA expects proof-of-concept demonstrations on a small-scale[13] by the end of Phase I. A critical criterion for the Phase I to Phase II transition will be evaluated on the feasibility of scaling EnMat size (>1 cm^3) to be compatible with practical optical devices. DARPA expects optical system architectures utilizing cm-scale multi-functional EnMats to be designed, fabricated, and tested by the end of Phase II. Architectures developed in TA2 may be composed of fully EnMat and/or hybrid components. Any EnMats capable of multiplexing optical functions may be proposed.

Groups proposing to TA2 should note that they must include sufficient modeling, design, and optimization capabilities to accomplish their TA2 goals. While they will interact throughout the program with TA3 performers, they should not depend on them for accomplishing their proposed tasks.

TA3: Modeling, Design, and Optimization

TA3 will develop novel concepts in the modeling, design, and optimization of optical systems based on EnMats, and is divided into two sub-TAs. TA3(a) focuses on physics-based models that can accurately simulate the electromagnetic response of a complete EnMat-based optical system over all relevant spatial scales (that potentially span seven orders of magnitude). Complementary to the multiscale models, work in TA3(b) will explore design concepts and optimization environments specifically tailored towards the development of disruptive EnMat-based optical system architectures. As noted above, proposers to TA1 and TA2 must provide

[13] Typically on the order of 10's to 100's micrometers in linear dimension.

their own modeling, design, and optimization capabilities to accomplish their TA1 and TA2 goals. Proposers with unique expertise relevant to TA3 may independently apply to TA3(a) and/or TA3(b), without corresponding TA1 or TA2 efforts.

TA3(a) Multiscale Physics-Based Modeling:

In Phase I, proposers will develop tools that not only design and optimize the fundamental EnMat building blocks, but can also predict how that design affects component/system performance across spatial scales. Importantly, it is highly desirable that this capability operates in the forward and inverse direction. That is, based on a desired system performance one could determine the optimal material features of the fundamental building block of the EnMat or vice versa. In Phase II, tools developed in Phase I will be applied to design new EnMat-based optical systems relevant to TA1 and TA2. Additionally, DARPA is interested in EnMat specific models that include, but are not limited to, meta-tronics[14], concepts for classifying and predicting the performance of resonant structures (e.g. a "periodic table" of metamaterial building blocks)[15], topological optimization of resonant structures[16], etc.

Independent proposals to TA3(a) do not have to address the challenge problem described below, but are expected to collaborate with all other members on the EXTREME program.

TA3(b) EnMat-based Optical Design and Optimization:

In Phase I, proposers will explore novel optical system architectures inspired by EnMat capabilities but are largely agnostic of specific EnMats. Over the course of Phase I, it is expected that system design tools and any architectures developed will begin to incorporate specific EnMat capabilities from TA1 and TA2 performers. In Phase II, architectures and optimization environments, developed in Phase I, will be incorporated with EnMats developed from TA1 and TA2.

Proposals that only apply to TA3(b) must address the design aspect of the challenge problem described below. It is intended that TA3(b)-only teams will closely collaborate with other members on the EXTREME program to build and test their design(s) in Phase II.

At the end of Phase II, it is expected TA3 will yield a suite of new predictive models, design tools, and optimization environments that help bridge the gap between scientific understanding and predictive engineering.

Integration of Efforts/Data Sharing and Collaboration

The EXTREME program seeks to build a close, synergistic coupling between TA1/TA2 work developing EnMats and the TA3 work developing multiscale models and new architectures.

[14] See note 8 above.
[15] See note 9 above.
[16] See not 10 above.

This is true both within teams and across the program. TA1/TA2 EnMat developers may offer capabilities that complement and extend the capabilities already existing within TA3 modelers/designers. Specifically, the EXTREME Program Manager may encourage TA1/TA2 teams to pose modeling challenges to the TA3 community that map well to the expertise offered by that community. Likewise, TA3 efforts may be encouraged to offer multiscale modeling, design, and optimization capabilities to TA1/TA2 efforts creating more avenues to develop high impact optical system architectures based on a team's specific EnMat technology. Thus, both communities may benefit by close interaction and collaboration. Therefore, all proposals must discuss not only initial partnerships and teaming arrangements but also discuss mechanisms and structures for formally sharing information, data, technical knowledge, expertise, and other resources to facilitate collaboration. Proposals must also discuss intellectual property (IP) arrangements and any potential barriers to collaboration. IP is discussed in further detail below and in Section VI.B.1. Proposals should clearly indicate whether software tools being developed will be made available to other EXTREME performers and/or to the community at large, and provide an expected timeline for information sharing.

It is important to again note that if applying to TA1 or TA2, proposers must include modeling, design, and optimization capabilities that focus on the specific EnMats and goals of their proposed work. Additionally, it is possible to apply only to TA3 (and thus not be a direct performer on any EnMat development), but the developed tools need to be much broader and should ideally incorporate several different classes of EnMats and functionality. For those only proposing to TA3, the developed tools will be made available to all program teams, and it is expected that TA3 performers will provide subject matter expertise to the TA1 and TA2 teams, and likewise TA1 and TA2 teams will provide EnMat prescriptions and design goals to TA3-only teams to improve the capability of the developed tools. DARPA expects this to be a completely collaborative activity to build crucial new capabilities.

DARPA wishes to emphasize that the ultimate goal of the EXTREME program is new optical architectures and capabilities, and not necessarily the advancement of any specific EnMat or component. Additionally, the "Modifying the Principles of Conventional Optics" and "Multifunctional Optics" are likely not mutually exclusive capabilities, and EnMats capable of both are likely possible and acceptable. DARPA emphasizes that EnMat development that is not specifically tied to and motivated by new architectures is not of interest to the EXTREME program.

Transition to Phase II

Below are high-level goals for transition from Phase I to Phase II. Further information about what constitutes success can be found in Table 1, Table 2, and the general issues described under the Technical Plan in the Full Proposal Section.

- Successful demonstration of EnMat devices on a small-scale
- Successful application of TA3 modeling tools to problems of interest from TA1 and TA2
- Feasible concepts to model and fabricate EnMat devices on a cm-scale
- Plans, methods, and risk mitigation techniques to develop a cm-scale optical system based on EnMats

- Credible path for successful demonstration of the challenge problem

All proposals should discuss the risks in the proposed effort (ordered from highest to lowest), the proposed research and development path to address these risks, as well as mitigation strategies that reduce the risks early in the program. Proposers must also clearly describe how any prior and ongoing efforts will be leveraged for the proposed work.

Challenge Problem

In order to achieve the overall goals of the EXTREME program, as well as focus the development effort, TA1 and TA2 proposals must address the below architectural challenge problem. TA3(b) standalone proposals must address only the design aspect of the challenge problem, while TA3(a) standalone proposals are exempt from responding to the challenge problem:

Demonstrate (design, build, and test) an optical system architecture relevant to the DoD that achieves at least an order of magnitude SWaP reduction and/or revolutionary performance improvement over equivalent SOA system. The proposed architecture must utilize at least one EnMat component that either modifies the conventional laws of light propagation, or operates as a multifunctional optical element, or both, as described in TA1 and TA2. Each EnMat component in the proposed system must adhere to the metrics in Table 1.

Examples of challenge problems:

- A non-vignetting $\geq 2\pi$ steradian F/1 imager composed of reflective, catadioptric, and refractive with any number of EnMat components
- A single volume "sugar cube" which performs several different functions in the same volume
- Night vision goggles with the form factor of eye glasses
- Wavefront shaping: flat interfaces for arbitrary light bending and curved interfaces for no bending (e.g., aberrationless domes, etc.)
- Zero optical signature: surfaces for dynamic camouflaging (adaptive redistribution of light flow, total absorption/transmission, etc.)
- Light Beam and/or imager FOV steering over 2π, and other active systems without moving elements
- Task/feature specific optical systems that incorporate the majority of the "computation/processing" into the optical system
- A $4\ \pi$ steradian extremely fast imager based on a true Luneburg lens

DARPA emphasizes the fact that the systems listed above are for illustrative purposes only. Proposals do not have to address any specific challenge problem from the example list, and proposers are free to submit their own challenge problem. If proposers submit their own challenge problem, they must achieve revolutionary improvements relative to state-of-the-art (SOA) systems. Challenge problems on the example list do not carry preference over one another, nor do they carry preference over any proposer-submitted challenge problems.

Proposers must clearly define the DoD utility of the proposed challenge problem device/architecture and application, quantify the revolutionary and enabling new capability offered, and propose metrics and figures of merit that can be used during the course of the effort to enable an assessment of technical progress against current SOA.

In addition, proposers must technically justify proposed architecture(s), clearly specify the required metrics for device and materials, describe how these will be tested, and provide a credible plan to demonstrate the potential for a high-performance, potentially fieldable, optical device/architecture based on a well-defined schedule of development milestones and validations for both Phase I and Phase II. DoD applications and systems-level specifications will be expected to drive architectures and designs at both the device and materials level, from nanoscale to cm scale.

DARPA is specifically seeking new optical architectures and disruptive concepts that are enabled by EnMats, components, and devices. The proposed systems can either be entirely made from EnMats or a combination of EnMat and conventional optics operating in conjunction.

Table 1 provides a list of definitions, and required metrics, for the purpose of the EXTREME program. These definitions are applicable to all developed EnMats and establish a minimum set of requirements.

Definitions/Metrics	**Program Threshold**	**Program Objective**
Spectral Band of Operation: range of wavelengths over which the EnMat device can operate. Continuous coverage of a single band or multiple bands is highly desirable, but several (defined by proposers) narrow sub-bands within the overall band could be acceptable so long as it is sufficient for the proposed application. For the purposes of the EXTREME program the bands of interest are: VIS (400-700 nm), NIR (700-900 nm), SWIR (0.9-2.5 μm), MWIR (3-5 μm), and LWIR (8-14 μm). DARPA prefers solutions in the VIS and NIR bands.	1 band	2+ bands
Efficiency: ratio of total light intensity coupled into designed output over the input light intensity. Thus it accounts both for the effectiveness of the EnMat component and for any material losses. It is acceptable to use gain internal to the EnMat to achieve the prescribed efficiency metrics.	>95%	>99%

Overall Component Size: the area or volume of the entire EnMat component.	Surface: ≥ $(1\ cm)^2$ Volume: ≥ $(1\ cm)^3$	Surface: ≥ $(2.54\ cm)^2$ Volume: ≥ $(2.54\ cm)^3$
Reconfigurable/tunable EnMats: materials with properties that can be altered as a function of time. The mechanisms of re-configurability can include, but are not limited to, mechanical, electrical, magnetic, optical, or thermal. Some examples include dynamic refract and reflect arrays, beam steering devices, stretchable and bendable materials, reconfigurable functionality, etc.	While not required, EnMats which are reconfigurable or tunable are of great interest. Requirements for these EnMats will be determined by the specific application and appropriate metrics will be supplied by proposer. Any proposed dynamic EnMats must be reconfigurable on a timescale that is commensurate with the proposed application.	

Table 1: Definition of programmatic parameters and metrics

Schedule/Milestones

Subject to the availability of funding, the program will run for 48 months. Proposers should specify the research and technology development schedule for the full period of performance, split between Phase I (24 months) and an Option Phase II (24 months). All proposals must include a detailed schedule that explicitly addresses the program milestones outlined herein. A target start date of April 2017 may be assumed for planning purposes. Schedules will be synchronized across performers, as required, and monitored/revised as necessary throughout the program.

Example milestones for each Technical Area are listed below:

Technical Area	Phase I	Phase II
TA1	• Establish the fundamental limits to which EnMats can modify conventional light propagation laws • Design EnMats which overcome limitations that currently prohibit their use in practical systems (e.g., efficiency, bandwidth, polarization (in)sensitivity, etc.) • Demonstrate a small scale EnMat device that achieves derived fundamental limits	• Design an optical system that utilizes centimeter scale EnMat components developed in Phase I (possibly in conjunction with conventional optics and/or TA2 EnMats) to address the challenge problem • Fabricate and demonstrate the designed system

TA2	• Analyze capability of EnMats to multiplex functionality including fundamental limits and tradeoffs • Develop concepts to address current limitations of EnMats (e.g., efficiency, bandwidth, internal gain, polarization (in)sensitivity, etc.) • Demonstrate a small scale EnMat device that achieves derived fundamental limits of multi-functionality	• Design an optical system that utilizes centimeter scale multifunctional EnMat component(s) developed in Phase I (possibly in conjunction with conventional optics and/or TA1 EnMats) to address the challenge problem • Fabricate and demonstrate the designed system
TA3	• Develop tools for the modeling of EnMats from the nanometer to centimeter scale • Establish a relationship between the geometry of nano- and micro-scale EnMat building blocks and centimeter scale performance • Create design tools and optimization environments for the development of EnMat-based optical system architectures	• Utilize multiscale models, design tools, and optimization environments from Phase I to aid in the design and optimization of centimeter scale EnMat systems developed in TAs 1 & 2

Table 2: Example Milestones

The statement of work (SOW) must cite specific subtasks and their connection to the program milestones, as applicable. Each phase of the program should be separately defined. To the extent practical, the SOW should be organized by the work required to achieve a particular technical objective on each Task.

Meetings and Travel

All proposals must include costs for any associated travel. Proposers must be prepared to support the following meetings:

- A multi-day Principal Investigator (PI) meeting will be held approximately every six months, with locations split between the East and West Coasts of the United States. The goals of the PI meetings will be to: (a) review the accomplishments of each performer, (b) enable open discussion among all performers, and (c) provide guidance and potential course corrections based on the accomplished progress towards milestones.
- The EXTREME Program Manager will hold a Quarterly Progress Review (QPR) with each performer during which the performer will have the opportunity to demonstrate progress toward agreed-upon milestones. The QPRs will be held approximately every three months with every other meeting coinciding with an EXTREME PI meeting. For example:
    - Month 3: QPR at performer site

    - Month 6: PI meeting (day one) + QPR (day two) in Arlington, VA
    - Month 9: QPR at performer site
    - Month 12: PI meeting (day one) + QPR (day two) in San Francisco, CA
- Regular teleconference meetings will be scheduled with the Government team for progress reporting as well as problem identification and mitigation.

Deliverables

All performers will be required to provide, at a minimum, the following deliverables:

- Negotiated deliverables specific to the objectives of the individual Tasks. These may include, but are not limited to:
    - all theory, algorithms, software code;
    - device characterization data;
    - model validation data;
    - data supporting spatial scalability of EnMats; and
    - test results (for both successful and failed experiments).
- Comprehensive annual technical reports due within ten days of the end of the given period describing progress made on the specific milestones as laid out in the SOW and any pertinent test results.
- Brief 6 week updates from the lead PI in the form of an email/short report indicating progress or problems, including PDFs of preprints of technical reports or papers produced during the month.
- A final report submitted within 30 days of the end of each phase describing the research done and its results.
- Reporting as outlined in Section VI.C.

TA 1 & TA 2

By the end of Phase I, deliverables are expected in the form of reports and published research describing concepts for next generation engineered materials, and initial proof-of-concept hardware demonstrations. At the end of Phase II, DARPA expects deliverables in the form of validation data for fabricated hardware systems.

TA 3

By the end of Phase I, deliverables are expected in the form of reports and published research describing multi-scale modeling, design tools, and optimization frameworks. Modeling software and/or optimization packages developed will also be delivered. By the end of Phase II, DARPA expects deliverables in the form of design specifications for systems and/or new EnMats based on software developed in Phase I.

Intellectual Property

A key goal of the program is to advance both the theoretical foundations and modeling and engineering tools for a wide range of EnMat-based optical systems. DARPA is therefore interested in mechanisms to best disseminate these new capabilities to the community, including the use of open, standards-based, plug and play software architectures that allow for

interoperability and integration. It is desired that noncommercial software, documentation, designs and technical data generated by the program be provided as deliverables to the Government, with a minimum of Government Purpose Rights (GPR). See Section VI.B.1 for more details on intellectual property.

II. Award Information

A. Awards

Multiple awards are anticipated. The level of funding for individual awards made under this solicitation has not been predetermined and will depend on the quality of the proposals received and the availability of funds. Awards under this solicitation will be made to proposers whose proposals are determined to be the most advantageous and provide best value to the Government, all factors considered, including the potential contributions of the proposed work, overall funding strategy, and availability of funding. See Section V for further information.

The Government reserves the right to:

- select for negotiation all, some, one, or none of the proposals received in response to this solicitation;
- make awards without discussions with proposers;
- conduct discussions with proposers if it is later determined to be necessary;
- segregate portions of resulting awards into pre-priced options;
- accept proposals in their entirety or to select only portions of proposals for award;
- fund proposals in increments with options for continued work at the end of one or more phases;
- request additional documentation once the award instrument has been determined (e.g., representations and certifications); and
- remove proposers from award consideration should the parties fail to reach agreement on award terms within a reasonable time or the proposer fails to provide requested additional information in a timely manner.

Proposals identified for negotiation may result in a procurement contract, cooperative agreement, or other transaction (OT), depending upon the nature of the work proposed, the required degree of interaction between parties, and other factors.

In all cases, the Government contracting officer shall have sole discretion to select award instrument type and to negotiate all instrument terms and conditions with selectees. Proposers are advised that regardless of the instrument type proposed, DARPA personnel, in consultation with the Government contracting officer, may select other award instruments, as they deem appropriate. DARPA will apply publication or other restrictions, as necessary, if it determines that the research resulting from the proposed effort will present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Any award resulting from such a determination will include a requirement for DARPA permission before publishing any information or results on the program. For more information on publication restrictions, see the section below on Fundamental Research.

B. Fundamental Research

It is DoD policy that the publication of products of fundamental research will remain unrestricted to the maximum extent possible. National Security Decision Directive (NSDD) 189 established the national policy for controlling the flow of scientific, technical, and engineering information produced in federally funded fundamental research at colleges, universities, and laboratories. The Directive defines fundamental research as follows:

> 'Fundamental research' means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

As of the date of publication of this BAA, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research. The Government does not anticipate applying publication restrictions of any kind to individual awards for fundamental research that may result from this BAA. Notwithstanding this statement of expectation, the Government 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. If proposals are selected for award that offer other than a fundamental research solution, the Government will either work with the proposer to modify the proposed statement of work to bring the research back into line with fundamental research or else the proposer will agree to restrictions in order to receive an award.

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 select award instrument type and to negotiate all instrument terms and conditions with selectees. Appropriate clauses will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate.

For certain research projects, it may be possible that although the research being performed by the prime contractor is restricted research, a subawardee may be conducting fundamental research. In those cases, it is the prime contractor's responsibility to explain in its proposal why its subawardee's effort is fundamental research.

The following statement or similar 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 subawardees, of information developed under this contract or contained in the reports to be furnished pursuant to this contract without prior written approval of DARPA's Public Release Center (DARPA/PRC). 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. With regard to

subawardee proposals for Fundamental Research, papers resulting from unclassified 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/PRC 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 (e.g., briefing, report, abstract, article, or paper); (2) Event Information: event type (conference, principal 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, email 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 may be sent either via email to public_release_center@darpa.mil or by mail at 675 North Randolph Street, Arlington VA 22203-2114, telephone (571) 218-4235. Refer to the following for link for information about DARPA's public release process: http://www.darpa.mil/work-with-us/contract-management/public-release."

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.

1. Federally Funded Research and Development Centers (FFRDCs) and Government Entities

Federally Funded Research and Development Centers (FFRDCs) and Government entities (e.g., 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: (1) FFRDCs must clearly demonstrate that the proposed work is not otherwise available from the private sector; and (2) FFRDCs must provide a letter on official letterhead from their sponsoring organization citing the specific authority establishing their eligibility to propose to Government solicitations and compete with industry, and their compliance with the associated FFRDC sponsor agreement's terms and conditions. This information is required for FFRDCs proposing to be prime contractors or subawardees. 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 and contractual authority, if relevant, 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 FFRDC and Government entity eligibility submissions on a case-by-case basis; however, the burden to prove eligibility for all team members rests solely with the proposer.

2. Foreign Participation

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.

B. 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 U.S.C. §§ 203, 205, and 208). Once the proposals have been received, and prior to the start of proposal evaluations, the Government will assess potential conflicts of interest and will promptly notify the proposer if any appear to exist. The Government assessment does NOT affect, offset, or mitigate the proposer's responsibility to give full notice and planned mitigation for all potential organizational conflicts, as discussed below.

Without prior approval or a waiver from the DARPA Director, in accordance with FAR 9.503, a contractor cannot simultaneously provide scientific, engineering, technical assistance (SETA) or similar support and also be a technical performer. As part of the proposal submission, all members of the proposed team (prime proposers, proposed subawardees, and consultants) must affirm whether they (their organizations and individual team members) are providing 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, subawardees, consultant, or individual supports and identify the prime contract number(s). All facts relevant to the existence or potential existence of organizational conflicts of interest (FAR 9.5) must be disclosed. The disclosure must include a description of the action the proposer has taken or proposes to take to avoid, neutralize, or mitigate such conflict. If in the sole opinion of the Government after full consideration of the circumstances, a proposal fails to fully disclose potential conflicts of interest and/or any identified conflict situation cannot be effectively mitigated, the proposal will be rejected without technical evaluation and withdrawn from further consideration for award.

If a prospective proposer believes a conflict of interest exists or may exist (whether organizational or otherwise) or has questions on what constitutes a conflict of interest, the proposer should send his/her contact information and a summary of the potential conflict via email to the BAA email address before time and effort are expended in preparing a proposal and mitigation plan.

C. Cost Sharing/Matching

Cost sharing is not required; however, it will be carefully considered where there is an applicable statutory condition relating to the selected funding instrument (e.g., OTs under the authority of 10 U.S.C. § 2371).

IV. Application and Submission Information

Prior to submitting a full proposal, proposers are *strongly encouraged* to first submit an abstract as described below. This process allows a proposer to ascertain whether the proposed concept is: (1) applicable to the EXTREME BAA and (2) currently of interest. For the purposes of this BAA, applicability is defined as follows:

- The proposed concept is applicable to the technical areas described herein.
- The proposed concept is important to DSO's current investment portfolio.
- The proposed concept investigates an innovative approach that enables revolutionary advances, i.e., will not primarily result in evolutionary improvements to the existing state of practice.
- The proposed work has not already been completed (i.e., the research element is complete but manufacturing/fabrication funds are required).
- The proposer has not already received funding or a positive funding decision for the proposed concept (whether from DARPA or another Government agency).

Abstracts and full proposals that are not found to be applicable to the EXTREME BAA as defined above may be deemed non-conforming[17] and removed from consideration. All abstracts and full proposals must provide sufficient information to assess the validity/feasibility of their claims as well as comply with the requirements outlined herein for submission formatting, content and transmission to DARPA. Abstracts and full proposals that fail to do so may be deemed non-conforming and removed from consideration. Proposers will be notified of non-conforming determinations via letter.

A. Address to Request Application Package

This document contains all information required to submit a response to this solicitation. No additional forms, kits, or other materials are needed except as referenced herein. No request for proposal or additional solicitation regarding this opportunity will be issued, nor is additional information available except as provided at the Federal Business Opportunities website (http://www.fbo.gov), the Grants.gov website (http://www.grants.gov/), or referenced herein.

B. Content and Form of Application Submission

1. Abstract Information

As stated above, proposers are strongly encouraged to submit an abstract in advance of a full proposal to minimize effort and reduce the potential expense of preparing an out of scope proposal. The abstract provides a synopsis of the proposed project by briefly answering the following questions:

- What is the proposed work attempting to accomplish or do?

[17] "Conforming" is defined as having been submitted in accordance with the requirements outlined herein.

- How is it done today, and what are the limitations?
- Who will care and what will the impact be if the work is successful?
- How much will it cost, and how long will it take?

DARPA will respond to abstracts with a statement as to whether DARPA is interested in the idea. If DARPA does not recommend the proposer submit a full proposal, DARPA will provide feedback to the proposer regarding the rationale for this decision. Regardless of DARPA's response to an 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 an abstract.

While it is DARPA policy to attempt to reply to abstracts within thirty calendar days, proposers to this solicitation may anticipate a response within approximately two weeks.

Abstracts must not be submitted to DARPA via email. See Section IV.E.1 for abstract submission instructions.

a. Abstract Format

All pages shall be formatted for printing on 8-1/2 by 11 inch paper with 1-inch margins and font size not smaller than 12 point. Font sizes of 8 or 10 point may be used for figures, tables, and charts. Document files must be in .pdf, .ppt, .pptx, .odx, .doc, .docx, .xls, or .xlsx formats. Submissions must be written in English.

Abstracts shall not exceed a maximum of 6 pages. If proposing to more than one technical area, only submit one abstract.

Page limit includes:	Page limit does NOT include:
All figures	Official transmittal letter (optional)
All tables	Cover Sheet
All charts	Executive summary slide
	Bibliography. While not included in the overall page limit, the bibliography should not exceed 2 pages.
	Technical Papers and Resumes

Abstracts must include the following components:

i. Cover Sheet: Provide the following information:

(1) Label: "Abstract"
(2) BAA number (DARPA-BAA-16-58)
(3) Technical Area(s)
(4) Abstract title
(5) Lead organization name
(6) Technical point of contact (POC) including name, mailing address, telephone, and email address

(7) Administrative POC including name, mailing address, telephone number, and email address
(8) Estimated total cost
(9) Estimated period of performance
(10) Primary subcontractors (if known/applicable)
(11) Identify any other solicitation(s) to which this concept has been proposed

ii. Executive Summary Slide: Provide a one slide summary in PowerPoint that effectively and succinctly conveys the main objective, key innovations, expected impact, and other unique aspects of the proposed project. A slide template is provided as Attachment 1 to the BAA posted at www.fbo.gov. Proposers must use the provided template.

iii. Goals and Impact: Describe what is being proposed and what difference it will make (qualitatively and quantitatively) if successful. Describe the innovative aspects of the project in the context of existing capabilities and approaches, clearly delineating the relationship of this work to any other projects from the past and present. Address how the proposed approach is revolutionary and how it rises above the current state of practice.

iv. Technical Plan: Outline and address all technical challenges inherent in the approach and possible solutions for overcoming potential problems. Provide appropriate specific milestones (quantitative, if possible) at intermediate stages of the project to demonstrate progress.

v. Capabilities/Management Plan: Provide a brief summary of expertise of the team, including subcontractors and key personnel. Teaming arrangements do not need to be finalized at the time of abstract submission; however, mention of potential teaming/collaboration arrangements is encouraged. Identify a principal investigator for the project and include a description of the team's organization including roles and responsibilities. Describe the organizational experience in this area, existing intellectual property required to complete the project, and any specialized facilities to be used as part of the project. List Government-furnished materials or data assumed to be available.

vi. Cost and Schedule: Provide a cost estimate for resources (e.g., labor, materials) and any subcontractors over the proposed timeline of the project, broken down by Government fiscal year.

vii. Bibliography: Include a brief bibliography with *links* to relevant papers, reports, or resumes of key team members.

2. Full Proposal Information

Proposals consist of Volume 1: Technical and Management Volume (including mandatory subsection xiii - Administrative and National Policy Requirements); and Volume 2: Cost Volume.

To assist in proposal development, various templates have been provided along with the BAA posted at http://www.fbo.gov/. Attachment 1 is for the executive summary slide (introductory section of the Technical Volume), Attachment 2 is for the Technical and Management Volume, Attachment 3 is for the Cost Volume, and Attachment 4 is for the cost summary slides. The executive summary slide template (Attachment 1) and the cost summary slides (Attachment 4) are mandatory. While proposers are encouraged to use the templates for the Technical Volume (Attachment 2) and Cost Volume (Attachment 3), they are optional; proposers may use their own format as long as all of the information requested herein is provided.

Proposers are encouraged to submit concise, but descriptive, proposals. Specific examples of problems, approaches, or goals are preferred to qualitative generalities. The Government will not consider pages in excess of the page count limitation, as described herein. Proposals with fewer than the maximum number of pages will not be penalized. Information incorporated into the Cost Volume which is not related to cost will not be considered. Additional information not explicitly called for in the Technical and Management Volume must not be submitted with the proposal, but may be included as links in the bibliography. Such materials will be considered for the reviewers' convenience only and not evaluated as part of the proposal.

All pages in both the Technical and Management Volume and the Cost Volume shall be formatted for printing on 8-1/2 by 11-inch paper with 1-inch margins, single-line spacing, and a font size not smaller than 12 point. Font sizes of 8 or 10 point may only be used for figures, tables, and charts in the Technical and Management Volume. Document files must be in .pdf, .odx, .ppt, .pptx, .doc, .docx, .xls, or .xlsx formats. Submissions must be written in English.

Proposals not meeting the format prescribed herein may not be reviewed.

a. Volume 1: Technical and Management Proposal

Volume 1 shall not exceed a maximum of 35 pages if applying to one TA, and shall not exceed a maximum of 40 pages if applying to multiple TAs.

Page limit includes:	Page limit does NOT include:
Figures	Cover Sheet
Tables	Official transmittal letter
Charts	Table of Contents
Cost Summary	Administrative and National Policy Requirements (mandatory)
	Bibliography
	Technical papers and Resumes
	Executive Summary Slide
	Cost Summary Slides

Volume 1 must include the following components:

i. Cover Sheet: Include the following information.

(1) Label: "Proposal: Volume 1"

(2) BAA number (DARPA-BAA-16-58)
(3) Technical Area(s)
(4) Proposal title
(5) Proposer's reference number, if any
(6) Lead organization (prime contractor) name
(7) Type of organization, selected from the following categories: Large Business, Small Disadvantaged Business, Other Small Business, Historically Black Colleges and Universities (HBCU), Minority Institution (MI), Other Educational, or Other Nonprofit
(8) Technical point of contact (POC) including name, mailing address, telephone, and email address
(9) Administrative POC including name, mailing address, telephone number, and email address
(10) Total proposed cost separated by base award and any proposed option(s)
(11) Award instrument requested: procurement contract (specify type), cooperative agreement or OT.
(12) Place(s) and period(s) of performance
(13) List all other team members (subcontractors and consultants), including Technical POC name, organization and organization type
(14) Date proposal was prepared
(15) Proposal validity period

ii. Official Transmittal Letter

iii. Table of Contents

iv. {1} Executive Summary:
Provide a synopsis of the proposed project, including answers to the following questions:

- What is the proposed work attempting to accomplish or do?
- How is it done today, and what are the limitations?
- Who or what will be affected and what will be the impact if the work is successful?
- How much will it cost, and how long will it take?

The summary should include a description of the key technical challenges, a concise review of the technologies proposed to overcome these challenges and achieve the project's goal, and a clear statement of the novelty and uniqueness of the proposed work.

Executive Summary Slide: Provide a one slide summary in PowerPoint that effectively and succinctly conveys the main objective, key innovations, expected impact, and other unique aspects of the proposed project. A slide template is provided as Attachment 1 to the BAA posted at www.fbo.gov. Proposers must use the provided template.

v. {3} Goals and Impact: Describe what the proposed EnMat-based optical system

architecture is trying to achieve and the difference it will make (qualitatively and quantitatively) if successful. Describe the innovative aspects of the project in the context of existing capabilities and approaches, clearly delineating the uniqueness and benefits of this project in the context of the state of the art, alternative approaches, and other projects from the past and present. Describe how the proposed project is revolutionary and how it significantly rises above the current state of the art.

Describe the deliverables associated with the proposed project and any plans to commercialize the technology, transition it to a customer, or further the work. Discuss the mitigation of any issues related to sustainment of the technology over its entire lifecycle, assuming the technology transition plan is successful.

vi. {15-20} Technical Plan: Outline and address technical challenges inherent in the approach and possible solutions for overcoming potential problems. Demonstrate a deep understanding of the technical challenges and present a credible (even if risky) plan to achieve the project's goal. Discuss mitigation of technical risk. Provide appropriate measurable milestones (quantitative if possible) at intermediate stages of the project to demonstrate progress, and a plan for achieving the milestones. List Government-furnished materials or data assumed to be available.

While unique challenges may exist for a given EnMat and conceived system architecture, proposals to TA1 and TA2 must include discussion of the following general issues:

- Top level description of the proposed architecture and how it utilizes EnMat capabilities
- Strategies and risk mitigation techniques to achieve the required efficiency and spectral bandwidth at the EnMat component level to successfully demonstrate full-scale optical systems;
- Methods for scaling from small-scale devices to centimeter-scale including a description of challenges likely to be encountered in fabrication and complementary risk mitigation strategies

While unique challenges may exist for a given modeling, design, and optimization process, the following general issues in TA3 must be addressed:

<u>TA3(a)</u>

- Estimate of computation time and explanation of how the proposed models will be amenable to integration with iterative optimizers
- How the proposed model will maintain accuracy across scales, specifically including discussion on tolerancing of system performance with respect to EnMat features
- Phase II transition plan on how to incorporate the proposed model with TA3(b) optical design and optimization software
- Strategies to integrate with EnMats from TA1 & TA2 and methods to share code, software, design, and optimization results.

TA3(b)

- Validation checks/techniques to ensure that the proposed design and optimization framework does not violate fundamental physics (e.g. Fermat's principle, conservation of étendue, etc.)
- How the proposed design and optimization environment accurately represents EnMat physics and capabilities
- Phase II transition plan on how to incorporate the proposed design and optimization environment with TA3(a) multiscale models
- Strategies to integrate with EnMats from TA1 & TA2 and methods to share code, software, design, and optimization results.

vii. {3} Management Plan: Provide a summary of expertise of the proposed team, including any subcontractors/consultants and key personnel who will be executing the work. Identify a principal investigator (PI) for the project. Provide a clear description of the team's organization including an organization chart that includes, as applicable, the relationship of team members; unique capabilities of team members; task responsibilities of team members; teaming strategy among the team members; and key personnel with the amount of effort to be expended by each person during the project. Provide a detailed plan for coordination including explicit guidelines for interaction among collaborators/subcontractors of the proposed project. Include risk management approaches. Describe any formal teaming agreements that are required to execute this project.

viii. {2} Personnel, Qualifications, and Commitments: List key personnel (no more than one page per person), showing a concise summary of their qualifications, discussion of previous accomplishments, and work in this or closely related research areas. Indicate the level of effort in terms of hours to be expended by each person during each contract year and other (current and proposed) major sources of support for them and/or commitments of their efforts. DARPA expects all key personnel associated with a proposal to make substantial time commitment to the proposed activity and the proposal will be evaluated accordingly. It is DARPA's intention to put key personnel conditions into the awards, so proposers should not propose personnel that are not anticipated to execute the work.

ix. {2} Capabilities: Describe organizational experience in relevant subject area(s), existing intellectual property, or specialized facilities. Discuss any work in closely related research areas and previous accomplishments. Identify other solicitation(s) to which this concept has been proposed. If applicable, state whether funding or a positive funding decision has already been received, and from which agency.

x. {4} Statement of Work (SOW): The SOW must provide a detailed task breakdown, citing specific tasks and their connection to the interim milestones and metrics, as applicable. Each year and phase of the project should be separately defined. The SOW must not include proprietary information. For each defined task/subtask, provide:

- A general description of the objective.

- A detailed description of the approach to be taken to accomplish each defined task/subtask (including, where applicable, identifying the tasks/subtasks that will be performed on campus at a university).
- Identification (by name) of the primary organization (prime contractor, subcontractor(s), consultant(s)) responsible for task/subtask execution.
- A measurable milestone (e.g., a deliverable, demonstration, or other event/activity that marks task completion).
- A definition of all deliverables (e.g., data, reports, software) to be provided to the Government in support of the proposed tasks/subtasks.

xi. {3} Schedule and Milestones: Provide a detailed schedule showing tasks (task name, cost, duration, work breakdown structure element as applicable, performing organization), milestones, and the interrelationships among tasks. The task structure must be consistent with that in the SOW. Measurable milestones should be clearly articulated and defined in time relative to the start of the project.

xii. {2} Cost Summary: Provide the cost summary as described in Section IV.B.2.b.ii.(1). Additionally, proposals must detail tasks and associated costs as detailed in Attachment 4

xiii. Administrative and National Policy Requirements: This section is mandatory and must include ALL of the following components. If a particular subsection is not applicable, state "NONE" (i.e., do not delete the subsection or leave it blank).

(1). Team Member Identification: Provide a list of all team members including the prime, subcontractor(s), and consultant(s), as applicable. Identify specifically whether any are a non-US organization or individual, FFRDC and/or Government entity. Use the following format for this list:

Prime				
Individual Name:	**Organization:**	Non-U.S. Organization:	☐ Yes	☐ No
		Non-U.S. Individual:	☐ Yes	☐ No
		FFRDC:	☐ Yes	☐ No
		U.S. Government Entity:	☐ Yes	☐ No
Subcontractors/Consultants				
Individual Name:	**Organization:**	Non-U.S. Organization:	☐ Yes	☐ No
		Non-U.S. Individual:	☐ Yes	☐ No
		FFRDC:	☐ Yes	☐ No
		U.S. Government Entity:	☐ Yes	☐ No
Individual Name:	**Organization:**	Non-U.S. Organization:	☐ Yes	☐ No
		Non-U.S.US Individual:	☐ Yes	☐ No
		FFRDC:	☐ Yes	☐ No
		U.S. Government Entity:	☐ Yes	☐ No

(2). Government or FFRDC Team Member Proof of Eligibility to Propose: If any of the team member organizations are a Government entity or FFRDC, provide documentation (per Section III.A.1) citing the specific authority that establishes the applicable team member's eligibility to propose to Government solicitations to

include: (1) statutory authority; (2) contractual authority; (3) supporting regulatory guidance; and (4) evidence of agency approval for applicable team member participation.

(3). Government or FFRDC Team Member Statement of Unique Capability: If any of the team member organizations are a Government entity or FFRDC, provide a statement (per Section III.A.1) that demonstrates the work to be performed by the Government entity or FFRDC team member is not otherwise available from the private sector.

(4). Organizational Conflict of Interest Affirmations and Disclosure: If none of the proposed team members is currently providing SETA or similar support as described in Section III.B, state "NONE."

If any of the proposed team members (individual or organization) is currently performing SETA or similar support, provide the following information:

Prime Contract Number	DARPA Office supported	Description of any action the proposer has taken or proposes to take to avoid, neutralize, or mitigate the conflict

(5). Intellectual Property (IP): If no IP restrictions are intended, state "NONE." The Government will assume unlimited rights to all IP not explicitly identified as restricted in the proposal.

For all technical data or computer software that will be delivered to the Government with other than unlimited rights, provide (per Section VI.B.1) a list describing all proprietary claims to results, prototypes, deliverables or systems supporting and/or necessary for the use of the research, results, prototypes and/or deliverables. Provide documentation proving ownership or possession of appropriate licensing rights to all patented inventions (or inventions for which a patent application has been filed) to be used for the proposed project. Use the following format for these lists:

NONCOMMERCIAL				
Technical Data and/or Computer Software To be Delivered With Restrictions	**Summary of Intended Use in the Conduct of the Research**	**Basis for Assertion**	**Asserted Rights Category**	**Name of Person Asserting Restrictions**

COMMERCIAL				
Technical Data and/or Computer Software To	**Summary of Intended Use in**	**Basis for Assertion**	**Asserted Rights**	**Name of Person Asserting Restrictions**

be Delivered With Restrictions	the Conduct of the Research		Category	

(6). Human Subjects Research (HSR): If HSR is not a factor in the proposal, state "NONE."

If the proposed work will involve human subjects, provide evidence of or a plan for review by an institutional review board (IRB). For further information on this subject, see Section VI.B.2.

(7). Animal Use: If animal use is not a factor in the proposal, state "NONE."

If the proposed research will involve animal use, provide a brief description of the plan for Institutional Animal Care and Use Committee (IACUC) review and approval. For further information on this subject, see Section VI.B.3.

(8). Representations Regarding Unpaid Delinquent Tax Liability or a Felony Conviction under Any Federal Law: Per Section VI.B.10, complete the following statements.

(a) The proposer represents that it is [ ] is not [ ] a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

(b) The proposer represents that it is [ ] is not [ ] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

xiv. Bibliography: Include a brief bibliography with links to relevant papers, reports, or resumes.

b. Volume 2 - Cost Proposal

This volume is mandatory and must include all the listed components. No page limit is specified for this volume. The Cost Proposal shall be formatted for printing on 8-1/2 by 11-inch paper with 1-inch margins, single-line spacing, and a font size not smaller than 12 point for all document files. Submissions must be written in English.

The cost proposal should include a spreadsheet file (.xls or equivalent format) that addresses the applicable cost information requested below and provides formula traceability among all components of the cost proposal. The spreadsheet file must be included as a separate file in the full proposal package. Costs must be traceable between the prime proposer and all

subcontractors/consultants, as well as between the cost proposal and the SOW. This includes ensuring a consistent task structure across all proposal documents. Cost information must be provided in sufficient detail to substantiate the proposed prices.

i. Cover Sheet:

(1) Label: "Proposal: Volume 2"
(2) BAA number (DARPA-BAA-16-58)
(3) Technical Area(s)
(4) Proposal title
(5) Proposer's reference number, if applicable
(6) Lead organization (prime proposer) name
(7) Type of organization, selected from the following categories: Large Business, Small Disadvantaged Business, Other Small Business, HBCU, MI, Other Educational, or Other Nonprofit
(8) Technical point of contact (POC) including name, mailing address, telephone, and email address
(9) Administrative POC including name, mailing address, telephone number, and email address
(10) Total proposed cost separated by base award and any proposed option(s)
(11) Award instrument requested: procurement contract (specify type), cooperative agreement, other transaction
(12) Place(s) and period(s) of performance
(13) List all other team member(s) (subcontractors and consultants), if applicable; for each, provide the Technical POC name and organization
(14) Data Universal Numbering System (DUNS) number[18]
(15) Taxpayer identification number (TIN)[19]
(16) Commercial and Government Entity (CAGE) code[20]
(17) Name, address, and telephone number of the proposer's cognizant Defense Contract Management Agency (DCMA) administration office[21] or Office of Naval Research (ONR) administration office[22], if known
(18) Name, address, and telephone number of the proposer's cognizant Defense Contract Audit Agency (DCAA) audit office[23], if known
(19) Date proposal was prepared
(20) Proposal validity period

ii. Cost Summaries

[18] The DUNS number is used as the Government's contractor identification code for all procurement-related activities. Go to http://fedgov.dnb.com/webform/index.jsp to request a DUNS number (may take at least one business day). See Section VI.B.7 for further information.
[19] See http://www.irs.gov/businesses/small/international/article/0,,id=96696,00.html for information on requesting a TIN. Note, requests may take from 1 business day to 1 month depending on the method (online, fax, mail).
[20] A CAGE Code identifies companies doing or wishing to do business with the Federal Government. See Section VI.B.7 for further information.
[21] https://pubapp.dcma.mil/CASD/CasdSearch.do.
[22] http://www.onr.navy.mil/Contracts-Grants/Regional-Contacts.aspx.
[23] http://www.dcaa.mil/FAQs_Contractor.pdf.

(1) Cost Summary by Phase: Provide total effort cost by phase broken down by major cost items to include: labor costs, materials, travel, consultants, subcontracts, other direct charges (ODCs), indirect costs (overhead, fringe, general and administrative (G&A)), and any proposed fee for the project.

(2) Cost Summary by Task: Provide a summary of total effort costs by task.

(3) Cost Summary by Month: Provide a summary of projected funding requirements by month.

iii. Cost Details: Provide the following cost details broken down by phase and Government Fiscal Year (GFY). Include supporting documentation describing the method used to estimate costs.

(1) Direct Labor: Provide individual labor categories or persons, with associated labor hours and direct labor rates.

(2) Indirect Costs: Identify all indirect cost rates (Fringe Benefits, Overhead, G&A, Facilities Cost of Money, etc.) and the basis for each.

(3) Materials: Provide an itemized list of all proposed materials including quantities, unit prices, proposed vendors (if known), and the basis of estimate (e.g., quotes, prior purchases, catalog price lists, etc.). Any item that exceeds $5,000 must be supported with back-up documentation such as a copy of catalog price lists or quotes prior to purchase.

(4) Equipment Purchases: Provide an itemized list of all proposed equipment including quantities, unit prices, proposed vendors (if known) and the basis of estimate (e.g., quotes, prior purchases, catalog price lists, etc.). Any item that exceeds $5,000 must be supported with back-up documentation such as a copy of catalog price lists or quotes prior to purchase. Include any requests for Government-furnished equipment or information with cost estimates and delivery dates.

(5) Travel: Provide the purpose of the trip, number of trips, number of days per trip, departure and arrival destinations, number of people, etc.

(6) ODCs: Provide an itemized breakdown with costs. Backup documentation must be submitted to support proposed costs. An explanation of any estimating factors, including their derivation and application, must be provided.

(7) Cost Sharing: Provide the source, nature, and amount of any industry cost-sharing.

(8) Consultant Costs: Provide a copy of all consultants' proposed SOWs as well as signed consultant agreements or other documents which verify the proposed loaded daily / hourly rate, hours and any other proposed consultant costs (e.g., travel).

(9) Subcontractor Costs: Provide information requested above in subsections (1)-(7) for each proposed subcontractor. *All documentation must be prepared at the same level of detail as that required of the prime.* In addition, prime proposers must provide the following for all proposed subcontractors, as applicable:

- A copy of the proposed SOW as well as any documents which verify the proposed loaded daily / hourly rate, hours and any other proposed costs (e.g., travel).
- interdivisional work transfer agreements or evidence of similar arrangements; and
- A cost or price reasonableness analysis of proposed subcontractor prices as defined in FAR 15.404-3. Such analysis shall indicate the extent to which the prime contractor has negotiated subcontract prices.

The prime proposer is responsible for the compilation and submission of all non-proprietary subcontractor cost proposals. Proposal submissions will not be considered complete until the Government has received all subcontractor cost proposals.

Proprietary subcontractor cost proposals may be included as part of Volume 2 or emailed separately (by the subcontractor) to EXTREME@darpa.mil. Email messages must include "Subcontractor Cost Proposal" in the subject line and identify the principal investigator, prime proposer organization and proposal title in the body of the message.

iv. Rate Agreements: Provide any Forward Pricing Rate Agreement, Department of Health and Human Services (DHHS) rate agreement, other such approved rate information, or such documentation that may assist in expediting negotiations (if available).

v. Proposals Requesting a Procurement Contract: Provide the following information where applicable. Note: this information is not required for cooperative agreements or other transactions.

(1) Proposals for $750,000 or more (inclusive of all options): "Certified cost or pricing data" (as defined in FAR 2.101) will be required unless the proposer requests an exception in accordance with FAR 15.403. Furthermore, per Section VI.B.11, a proposal which may result in a CAS-compliant procurement contract, must include a Disclosure Statement as required by 48 CFR 9903.202.

(2) Proposals for $700,000 or more (inclusive of all options): Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)), it is Government policy to enable small business and small disadvantaged business concerns to be considered fairly as subcontractors to organizations performing work as prime contractors or subcontractors under Government contracts, and to ensure that prime contractors and subcontractors carry out this policy. In accordance with FAR 19.702(a)(1) and

19.702(b), prepare a subcontractor plan, if applicable. The plan format is outlined in FAR 19.704.

(3) Proposals for a cost-type contract: Proposers who do not have a cost accounting system that has been deemed adequate for determining accurate costs must provide the DCAA Pre-award Accounting System Adequacy Checklist in order to facilitate DCAA's completion of Standard Form (SF) 1408. The checklist may be found at: http://www.dcaa.mil/preaward_accounting_system_adequacy_checklist.html.

vi. Proposals Requesting an Other Transaction for Prototypes: Provide the following information where applicable.

(1) Proposers must indicate whether they qualify as a nontraditional Defense contractor,[24] have teamed with a nontraditional Defense contractor, or are providing a one-third cost share for this effort. Provide information to support the claims.

(2) Provide a detailed list of milestones including: description, completion criteria, due date, and payment/funding schedule (to include, if cost share is proposed, contractor and Government share amounts). Milestones must relate directly to accomplishment of technical metrics as defined in the solicitation and/or the proposal. While agreement type (fixed price or expenditure based) will be subject to negotiation, the use of fixed price milestones with a payment/funding schedule is preferred. Proprietary information must not be included as part of the milestones.

3. Proprietary and Security Information

DARPA policy is to treat all submissions as source selection information (see FAR 2.101 and 3.104), and to disclose their contents only for the purpose of evaluation. Restrictive notices notwithstanding, during the evaluation process, submissions may be handled by support contractors for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors performing this role are expressly prohibited from performing DARPA-sponsored technical research and are bound by appropriate nondisclosure agreements.

Submissions will not be returned. The original of each submission 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.

a. Proprietary Information

Proposers are responsible for clearly identifying proprietary information. Submissions containing proprietary information must have the cover page and each page containing such information clearly marked with a label such as "Proprietary" or "Company Proprietary." Note, "Confidential" is a classification marking used to control the dissemination of U.S.

[24] For definitions and information on Other Transaction agreements see http://www.darpa.mil/work-with-us/contract-management and "Other Transactions (OT) Guide for Prototype Projects," dated January 2001 (as amended), at http://www.acq.osd.mil/dpap/Docs/otguide.doc.

Government National Security Information as dictated in Executive Order 13526 and should not be used to identify proprietary business information.

b. Security Information

Classified submissions shall be transmitted in accordance with the following guidance. Additional information on the subjects discussed in this section may be found at http://www.dss.mil/.

If a submission contains Classified National Security Information as defined by Executive Order 13526, the information must be appropriately and conspicuously marked with the proposed classification level and declassification date. Similarly, when the classification of a submission is in question, the submission must 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)"

NOTE: Classified submissions must indicate the classification level of not only the submitted materials, but also the classification level of the anticipated award.

Proposers submitting classified information must have, or be able to obtain prior to contract award, cognizant security agency approved facilities, information systems, and appropriately cleared/eligible personnel to perform at the classification level proposed. All proposer personnel performing Information Assurance (IA)/Cybersecurity related duties on classified Information Systems shall meet the requirements set forth in DoD Manual 8570.01-M (Information Assurance Workforce Improvement Program).

Proposers choosing to submit classified information from other collateral classified sources (i.e., sources other than DARPA) must ensure: (1) they have permission from an authorized individual at the cognizant Government agency (e.g., Contracting Officer, Program Manager); (2) the proposal is marked in accordance with the source Security Classification Guide (SCG) from which the material is derived; and (3) the source SCG is submitted along with the proposal.

DARPA anticipates that submissions received under this BAA will be unclassified. However, should a proposer wish to submit classified information, an *unclassified* email must be sent to the BAA mailbox requesting submission instructions from the DARPA/DSO Program Security Officer (PSO).

Security classification guidance and direction via a SCG and/or DD Form 254, "DoD Contract Security Classification Specification," will not be provided at this time, since DARPA is soliciting ideas only. If a determination is made that the award instrument may

result in access to classified information, a SCG and/or DD Form 254 will be issued by DARPA and attached as part of the award.

C. Submission Dates and Times

All times listed herein are in Eastern Time. Proposers are warned that submission deadlines as outlined herein are strictly enforced. When planning their response to this solicitation, proposers should take into account that some parts of the submission process may take from one business day to one month to complete (e.g., registering for a DUNS number or TIN).

NOTE: Proposers submitting an abstract or full proposal via the DARPA BAA Submission site (https://baa.darpa.mil/), MUST click the "Finalize" button with sufficient time for the upload to complete prior to the deadline. Failure to do so will result in a late submission.

DARPA will acknowledge receipt of complete submissions via email and assign identifying numbers that should be used in all further correspondence regarding those submissions. If no confirmation is received within two business days, please contact the BAA Administrator at EXTREME@darpa.mil to verify receipt.
Failure to comply with the submission procedures outlined herein may result in the submission not being evaluated.

1. Abstracts

Abstracts must be submitted per the instructions outlined herein *and received by DARPA* no later than 4:00 p.m. on September 9, 2016. Abstracts received after this time and date may not be reviewed.

2. Full Proposals

The proposal package--full proposal (Volumes 1 and 2) and, as applicable, proprietary subcontractor cost proposals, classified appendices to unclassified proposals-- must be submitted per the instructions outlined herein *and received by DARPA* no later than 4:00 p.m. on October 25, 2016. Proposals received after this time and date may not be reviewed.

D. Funding Restrictions

Not applicable.

E. Other Submission Requirements

1. Unclassified Submission Instructions

Proposers must submit all parts of their submission package using the same method; submissions cannot be sent in part by one method and in part by another method nor should duplicate submissions be sent by multiple methods. Email submissions will not be accepted.

a. Abstracts

DARPA/DSO will employ an electronic upload submission system (https://baa.darpa.mil/) for all UNCLASSIFIED abstracts sent in response to this solicitation. *Abstracts must not be submitted via Grants.gov.*

First time users of the DARPA BAA Submission website must complete a two-step account creation process. The first step consists of registering for an extranet account by going to the URL listed above and selecting the "Account Request" link. Upon completion of the online form, proposers will receive two separate emails; one will contain a user name and the second will provide a temporary password. Once both emails have been received, the second step requires proposers to go back to the submission website and log in using that user name and password. After accessing the extranet, proposers may then create a user account for the DARPA BAA Submission website by selecting the "Register your Organization" link at the top of the page. Once the user account is created, proposers will be able to see a list of solicitations open for submissions, view submission instructions, and upload/finalize their abstract.

Proposers who already have an account on the DARPA BAA Submission website may simply log in at https://baa.darpa.mil/, select this solicitation from the list of open DARPA solicitations and proceed with their abstract submission. Note: proposers who have created a DARPA BAA Submission website account to submit to another DARPA Technical Office's solicitations do not need to create a new account to submit to this solicitation.

All abstracts submitted electronically through the DARPA BAA Submission website must meet the following requirements: (1) uploaded as a zip file (.zip or .zipx extension); (2) only contain the document(s) requested herein; (3) only contain unclassified information; and (4) must not exceed 100 MB in size. Only one zip file will be accepted per abstract and abstracts not uploaded as zip files will be rejected by DARPA.

Technical support for the DARPA BAA Submission website is available during regular business hours, Monday – Friday, 9:00 a.m. – 5:00 p.m. Requests for technical support must be emailed to BAAT_Support@darpa.mil with a copy to EXTREME@darpa.mil. Questions regarding submission contents, format, deadlines, etc. should be emailed to EXTREME@darpa.mil. Questions/requests for support sent to any other email address may result in delayed/no response.

Since proposers may encounter heavy traffic on the web server, proposers should not wait until the day abstracts are due to request an account and/or upload the submission.

b. Proposals Requesting a Procurement Contract or Other Transaction

Proposers requesting procurement contracts or other transactions may submit full proposals through ONE of the following methods: (1) direct mail/hand-carry; or (2) electronic upload (DARPA-preferred).

Direct Mail/Hand-carry:
Proposers electing to submit procurement contract or other transaction proposals via direct mail must provide one paper copy and one electronic copy on CD or DVD of the full proposal

package. All parts of the proposal package must be mailed or hand-carried to the address noted in Section VII below.

Electronic Upload:
DARPA/DSO encourages proposers to submit UNCLASSIFIED proposals via the DARPA BAA Submission website at https://baa.darpa.mil/.

First time users of the DARPA BAA Submission website must complete a two-step account creation process. The first step consists of registering for an extranet account by going to the URL listed above and selecting the "Account Request" link. Upon completion of the online form, proposers will receive two separate emails; one will contain a user name and the second will provide a temporary password. Once both emails have been received, the second step requires proposers to go back to the submission website and log in using that user name and password. After accessing the extranet, proposers may then create a user account for the DARPA BAA Submission website by selecting the "Register your Organization" link at the top of the page. Once the user account is created, proposers will be able to see a list of solicitations open for submissions, view submission instructions, and upload/finalize their proposal.

Proposers who already have an account on the DARPA BAA Submission website may simply log in at https://baa.darpa.mil/, select this solicitation from the list of open DARPA solicitations and proceed with their proposal submission. Note: proposers who have created a DARPA BAA Submission website account to submit to another DARPA Technical Office's solicitations do not need to create a new account to submit to this solicitation.

All full proposals submitted electronically through the DARPA BAA Submission website must meet the following requirements: (1) uploaded as a zip file (.zip or .zipx extension); (2) only contain the document(s) requested herein; (3) only contain unclassified information; and (4) must not exceed 100 MB in size. Only one zip file will be accepted per full proposal and full proposals not uploaded as zip files will be rejected by DARPA.

Technical support for the DARPA BAA Submission website is available during regular business hours, Monday – Friday, 9:00 a.m. – 5:00 p.m. Requests for technical support must be emailed to BAAT_Support@darpa.mil with a copy to EXTREME@darpa.mil. Questions regarding submission contents, format, deadlines, etc. should be emailed to EXTREME@darpa.mil. Questions/requests for support sent to any other email address may result in delayed/no response.

Since proposers may encounter heavy traffic on the web server, proposers should not wait until the day proposals are due to request an account and/or upload the submission.

c. Proposals Requesting a Cooperative Agreement

Proposers requesting cooperative agreements may submit proposals through one of the following methods: (1) hard copy mailed directly to DARPA; or (2) electronic upload per the instructions at http://www.grants.gov/applicants/apply-for-grants.html. Cooperative agreement proposals may not be submitted through any other means. If proposers intend to

use Grants.gov as their means of submission, then they must submit their entire proposal through Grants.gov; applications cannot be submitted in part to Grants.gov and in part as a hard-copy. Proposers using the Grants.gov do not submit paper proposals in addition to the Grants.gov electronic submission.

Direct Mail/Hand-carry:
Proposers electing to submit cooperative agreement proposals via direct mail must provide one paper copy and one electronic copy on CD or DVD of the full proposal package. Proposals must include a completed SF 424 R&R form (Application for Federal Assistance, Research and Related) available on the Grants.gov website http://apply07.grants.gov/apply/forms/sample/RR_SF424_2_0-V2.0.pdf. All parts of the proposal package must be mailed or hand-carried to the address noted in Section VII below.

Electronic Upload:
DARPA encourages cooperative agreement proposers to submit their proposals via electronic upload at http://www.grants.gov/web/grants/applicants/apply-for-grants.html. Proposers electing to use this method must complete a one-time registration process on Grants.gov before a proposal can be electronically submitted. *If proposers have not previously registered, this process can take between three business days and four weeks if all steps are not completed in a timely manner.* See the Grants.gov user guides and checklists at http://www.grants.gov/web/grants/applicants/applicant-resources.html for registration requirements and instructions.

Carefully follow the DARPA submission instructions provided with the solicitation application package on Grants.gov. Only the required forms listed therein (e.g., SF-424 and Attachments form) should be included in the submission. *Please note that Grants.gov does not accept zipped or encrypted proposals.*

Once Grants.gov has received an uploaded proposal submission, Grants.gov will send two email messages to notify proposers that: (1) the proposal has been received by Grants.gov; and (2) the proposal has been either validated or rejected by the system. *It may take up to two business days to receive these emails.* If the proposal is validated, then the proposer has successfully submitted their proposal. If the proposal is rejected, the submission must be corrected, resubmitted and revalidated before DARPA can retrieve it. If the solicitation is no longer open, the rejected proposal cannot be resubmitted. Once the proposal is retrieved by DARPA, Grants.gov will send a third email to notify the proposer.

Technical support for Grants.gov submissions may be reached at 1-800-518-4726 or support@grants.gov.

To avoid missing deadlines, proposers should submit their proposals to Grants.gov in advance of the proposal due date, with sufficient time to complete the registration and submission process, receive email notifications and correct errors, as applicable.

V. Application Review Information

A. 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.

- *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.

  The 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.

- *Potential Contribution and Relevance to the DARPA Mission*
  The potential contributions of the proposed effort are relevant to the national technology base. 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 application.

  The proposed intellectual property restrictions (if any) will not significantly impact the Government's ability to transition the technology.

- *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 subawardees 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).

B. Proposal Review and Selection Process

The review process identifies proposals that meet the evaluation criteria described above and are, therefore, selectable for negotiation of awards by the Government. DARPA policy is to ensure impartial, equitable, comprehensive proposal evaluations and to select proposals that meet DARPA technical, policy, and programmatic goals. If necessary, panels of experts in the appropriate areas will be convened. As described in Section IV, proposals must be deemed conforming to the solicitation to receive a full technical review against the evaluation criteria; proposals deemed non-conforming will be removed from consideration.

DARPA will conduct a scientific/technical review of each conforming proposal. 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.

Selections may be made at any time during the period of solicitation. Pursuant to FAR 35.016, the primary basis for selecting proposals for award negotiation shall be technical, importance to agency programs, and fund availability. Conforming proposals based on a previously submitted abstract will be reviewed without regard to feedback resulting from review of that abstract. Furthermore, a favorable response to an abstract is not a guarantee that a proposal based on the abstract will ultimately be selected for award negotiation. Proposals that are determined selectable will not necessarily receive awards.

For evaluation purposes, a proposal is defined to be the document and supporting materials as described in Section IV.B.2. 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. No submissions, classified or unclassified, will be returned.

VI. Award Administration Information

A. Selection Notices

After proposal evaluations are complete, proposers will be notified as to whether their proposal was selected for award negotiation as a result of the review process. Notification will be sent by email to the Technical and Administrative POCs identified on the proposal cover sheet. If a proposal has been selected for award negotiation, the Government will initiate those negotiations following the notification.

B. Administrative and National Policy Requirements

The below table indicates which of the following administrative and national policy requirements apply to each type of proposed award instrument.

Section VI.B	Requirement	Procurement Contracts	Assistance Instruments*	Other Transaction for Prototype Agreements
1	Intellectual Property Assertions	Yes	Yes	Yes
2	Human Subjects Research	Yes	Yes	Yes
3	Animal Use	Yes	Yes	Yes
4	Export Control	Yes	Yes	Yes
5	Electronic & Information Technology	Yes	Yes	Yes
6	Employment Eligibility Verification	Yes	No	No
7	System for Award Management & Universal Identifier Requirements	Yes	Yes	Yes

8	Reporting Executive Compensation & First-Tier Subcontract Awards	Yes	Yes	No
9	Updates of Information Regarding Responsibility Matters	Yes	No	No
10	Representations by Corporations Regarding an Unpaid Delinquent Tax Liability or Felony Conviction Under Any Federal Law	Yes	Yes	Yes
11	Cost Accounting Standards Notices & Certification	Yes	No	No
12	Controlled Unclassified Information on Non-DoD Information Systems	Yes	Yes	Yes
13	Safeguarding of Unclassified Controlled Technical Information	Yes	No	No
14	Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements	Check for FY16	Check for FY16	Check for FY16
15	Publication of Grant Awards	No	Grants only	No

*Cooperative Agreements, Technology Investment Agreements

1. Intellectual Property

Proposers should note that the Government does not own the intellectual property or technical data/computer software developed under Government contracts. The Government acquires the right to use the technical data/computer software. Regardless of the scope of the Government's rights, performers may freely use their same data/software for their own commercial purposes (unless restricted by U.S. export control laws or security classification). Therefore, technical data and computer software developed under this solicitation will remain the property of the performers, though DARPA will have, at a minimum, Government Purpose Rights (GPR) to technical data and computer software developed through DARPA sponsorship.

If proposers desire to use proprietary computer software or technical data or both as the basis of their proposed approach, in whole or in part, they should: (1) clearly identify such software/data and its proposed particular use(s); (2) explain how the Government will be able to reach its program goals (including transition) within the proprietary model offered; and (3) provide possible nonproprietary alternatives in any area that might present transition difficulties or increased risk or cost to the Government under the proposed proprietary solution. Proposers expecting to use, but not to deliver, commercial open source tools or other materials in implementing their approach may be required to indemnify the Government against legal liability arising from such use.

All references to "Unlimited Rights" or "Government Purpose Rights" are intended to refer to the definitions of those terms as set forth in the Defense Federal Acquisition Regulation Supplement (DFARS) 227.

a. Intellectual Property Representations

All proposers must provide a good faith representation of either ownership or possession of appropriate licensing rights to all other intellectual property to be used for the proposed project. Proposers must 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.

b. Patents

All proposers must include documentation proving ownership or possession of appropriate licensing rights to all patented inventions to be used for the proposed project. If a patent application has been filed for an invention, but it includes proprietary information and is not publicly available, a proposer must provide documentation that includes: the patent number, inventor name(s), assignee names (if any), filing date, filing date of any related provisional application, and summary of the patent title, with either: (1) a representation of invention ownership; or (2) proof of possession of appropriate licensing rights in the invention (i.e., an agreement from the owner of the patent granting license to the proposer).

c. Procurement Contracts

- **Noncommercial Items (Technical Data and Computer Software):** Proposers requesting a procurement contract must list all noncommercial technical data and computer software that it plans to generate, develop, and/or deliver, in which the Government will acquire less than unlimited rights and to assert specific restrictions on those deliverables. In the event a proposer does not submit the list, the Government will assume that it has unlimited rights to all noncommercial technical data and computer software generated, developed, and/or delivered, unless it is substantiated that development of the noncommercial technical data and computer software occurred with mixed funding. If mixed funding is anticipated in the development of noncommercial technical data and computer software generated, developed, and/or delivered, proposers should identify the data and software in question as subject to GPR. In accordance with 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," the Government will automatically assume that any such GPR restriction is limited to a period of 5 years, at which time the Government will acquire unlimited rights unless the parties agree otherwise. 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. Failure to provide full information may result in a determination that the proposal is not compliant with the solicitation. A template for complying with this request is provided in Section IV.B.2.a.xiii.(5).

- **Commercial Items (Technical Data and Computer Software):** Proposers requesting a procurement contract must list all commercial technical data and commercial computer software that may be included in any noncommercial deliverables contemplated under the research project, and assert any applicable restrictions on the Government's use of such commercial technical data and/or

computer software. In the event a proposer does not submit the list, the Government will assume there are no restrictions on the Government's use of such commercial items. 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 to evaluate the proposer's assertions. Failure to provide full information may result in a determination that the proposal is not compliant with the solicitation. A template for complying with this request is provided in Section IV.B.2.a.xiii.(5).

d. Other Types of Awards

Proposers responding to this solicitation requesting an award instrument other than a procurement contract shall follow the applicable rules and regulations governing those 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. The Government may use the list as part of the evaluation process to assess the impact of any identified restrictions, and may request additional information from the proposer, to evaluate the proposer's assertions. Failure to provide full information may result in a determination that the proposal is not compliant with the solicitation. A template for complying with this request is provided in Section IV.B.2.a.xiii.(5).

2. Human Subjects Research

All research selected for funding involving human subjects, to include use of human biological specimens and human data, must comply with the federal regulations for human subjects protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, Protection of Human Subjects (and DoD Instruction 3216.02, Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research (http://www.dtic.mil/whs/directives/corres/pdf/321602p.pdf).

Institutions awarded funding for research involving human subjects must provide documentation of a current Assurance of Compliance with Federal regulations for human subjects protection, such as 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 subjects research, to include subawardees, must also hold a valid Assurance. In addition, all personnel involved in human subjects research must provide documentation of completion of human subjects research training.

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 as part of their proposal, prior to being selected for funding. The IRB conducting the review must be the IRB identified on the institution's Assurance of Compliance with human subjects protection regulations. 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. It is recommended that you 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 of Compliance with human subjects protection regulations along with evidence of completion of appropriate human subjects research training by all investigators and personnel involved with human subjects research should accompany the protocol for review by the IRB.

In addition to a local IRB approval, a headquarters-level human subjects administrative 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 of Compliance with human subjects protection regulations and appropriate human subjects research training is required before headquarters-level approval can be issued.

The time required to complete the IRB review/approval process varies depending on the complexity of the research and the level of risk involved with the study. The IRB approval process can last between one and three months, followed by a DoD review that could last between three and six months. Ample time should be allotted to complete the approval process. DoD/DARPA funding cannot be used towards human subjects research until ALL approvals are granted.

3. Animal Use

Award recipients performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling, and use as outlined in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Animal Welfare Act of 1966, as amended, (7 U.S.C. § 2131-2159); (ii) National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals" (8th Edition); and (iii) DoD Instruction 3216.01, "Use of Animals in DoD Programs."

For projects anticipating 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 Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, available at http://grants.nih.gov/grants/olaw/olaw.htm.

All award 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 United States Army Medical Research and Materiel Command (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 award recipient will be required to complete and submit an ACURO Animal Use Appendix, which may be found at https://mrmc-www.army.mil/index.cfm?pageid=Research_Protections.acuro&rn=1.

4. Export Control

Per DFARS 225.7901-4, all procurement contracts, other transactions and other awards, as deemed appropriate, resultant from this solicitation will include the DFARS Export Control clause (252.225-7048).

5. Electronic and Information Technology

All electronic and information technology acquired through this solicitation must satisfy the accessibility requirements of Section 508 of the Rehabilitation Act (29 U.S.C. § 794d) and FAR 39.2. Each project involving the creation or inclusion of electronic and information technology must ensure that: (1) Federal employees with disabilities will have access to and use of information that is comparable to the access and use by Federal employees who are not individuals with disabilities; and (2) members of the public with disabilities seeking information or services from DARPA will have access to and use of information and data that is comparable to the access and use of information and data by members of the public who are not individuals with disabilities.

6. Employment Eligibility Verification

As per FAR 22.1802, recipients of FAR-based procurement contracts must enroll as federal contractors in E-verify and use the system to verify employment eligibility of all employees assigned to the award. All resultant contracts from this solicitation will include FAR 52.222-54, "Employment Eligibility Verification." This clause will not be included in grants, cooperative agreements, or Other Transactions.

7. System for Award Management (SAM) and Universal Identifier Requirements

Unless the proposer is exempt from this requirement, as per FAR 4.1102 or 2 CFR 25.110 as applicable, all proposers must be registered in the System for Award Management (SAM) and have a valid Data Universal Numbering System (DUNS) number prior to submitting a proposal. All proposers must maintain an active registration in SAM with current information at all times during which they have an active Federal award or proposal under consideration by DARPA. All proposers must provide the DUNS number in each proposal they submit.

Information on SAM registration is available at www.sam.gov.

Note that new registrations can take an average of 7-10 business days to process in SAM. SAM registration requires the following information:

- DUNS number
- TIN
- CAGE Code. If a proposer does not already have a CAGE code, one will be assigned during SAM registration.
- Electronic Funds Transfer information (e.g., proposer's bank account number, routing number, and bank phone or fax number).

8. Reporting Executive Compensation and First-Tier Subcontract Awards

FAR clause 52.204-10, "Reporting Executive Compensation and First-Tier Subcontract Awards," will be used in all procurement contracts valued at $25,000 or more. A similar award term will be used in all grants and cooperative agreements.

9. Updates of Information Regarding Responsibility Matters

Per FAR 9.104-7(c), FAR clause 52.209-9, Updates of Publicly Available Information Regarding Responsibility Matters, will be included in all contracts valued at $500,000 or more where the contractor has current active Federal contracts and grants with total value greater than $10,000,000.

10. Representations by Corporations Regarding an Unpaid Delinquent Tax Liability or a Felony Conviction under any Federal Law

The following representation will be included in all awards:

(a) In accordance with section 101(a) of the Continuing Appropriations Act, 2016 (Pub. L. 114-53) and any subsequent FY 2016 appropriations act that extends to FY 2016 funds the same restrictions as are contained in sections 744 and 745 of division E, title VII, of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235), none of the funds made available by this or any other Act may be used to enter into a contract with any corporation that —

(1) Has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless the agency has considered suspension or debarment of the corporation and made a determination that this further action is not necessary to protect the interests of the Government; or

(2) Was convicted of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless the agency has considered suspension or debarment of the corporation and made a determination that this action is not necessary to protect the interests of the Government.

(b) The Offeror represents that –

(1) It is [ ] is not [ ] a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability,

(2) It is [ ] is not [ ] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

Each proposer must complete and return the representations outlined in Section IV.B.2.a.xiii.(8). with their proposal submission.

11. Cost Accounting Standards (CAS) Notices and Certification

As per FAR 52.230-2, any procurement contract in excess of the referenced threshold resulting from this solicitation will be subject to the requirements of the Cost Accounting Standards Board (48 CFR 99), except those contracts which are exempt as specified in 48 CFR 9903.201-1. Any proposer submitting a proposal which, if accepted, will result in a CAS compliant contract, must submit representations and a Disclosure Statement as required by 48 CFR 9903.202 detailed in FAR 52.230-2. The disclosure forms may be found at http://www.whitehouse.gov/omb/procurement_casb.

12. Controlled Unclassified Information (CUI) on Non-DoD Information Systems

Controlled Unclassified Information (CUI) refers to unclassified information that does not meet the standards for National Security Classification but is pertinent to the national interests of the United States or to the important interests of entities outside the Federal Government and under law or policy requires protection from unauthorized disclosure, special handling safeguards, or prescribed limits on exchange or dissemination. All non-DoD entities doing business with DARPA are expected to adhere to the following procedural safeguards, in addition to any other relevant Federal or DoD specific procedures, for submission of any proposals to DARPA and any potential business with DARPA:

- Do not process DARPA CUI on publicly available computers or post DARPA CUI to publicly available webpages or websites that have access limited only by domain or Internet protocol restriction.
- Ensure that all DARPA CUI is protected by a physical or electronic barrier when not under direct individual control of an authorized user and limit the transfer of DARPA CUI to subawardees or teaming partners with a need to know and commitment to this level of protection.
- Ensure that DARPA CUI on mobile computing devices is identified and encrypted and all communications on mobile devices or through wireless connections are protected and encrypted.
- Overwrite media that has been used to process DARPA CUI before external release or disposal.

13. Safeguarding of Covered Defense Information and Cyber Incident Reporting

Per DFARS 204.7304, DFARS 252.204-7012, "Safeguarding of Covered Defense Information and Cyber Incident Reporting," applies to this solicitation and all FAR-based awards resulting from this solicitation.

14. Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements

(a) In accordance with section 101(a) of the Continuing Appropriations Act, 2016 (Pub. L. 114-53) and any subsequent FY 2016 appropriations act that extends to FY 2016 funds the same restrictions as are contained in section 743 of division E, title VII, of the Consolidated and

Further Continuing Appropriations Act, 2015 (Pub. L. 113-235), none of the funds appropriated (or otherwise made available) by this or any other Act may be used for a contract with an entity that requires employees or subcontractors of such entity seeking to report fraud, waste, or abuse to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contactors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

(b) The prohibition in paragraph (a) of this provision does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(c) *Representation*. By submission of its offer, the Offeror represents that it does not require employees or subcontractors of such entity seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contactors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

C. Reporting

1. Technical and Financial Reports

The number and types of technical and financial reports required under the contracted project will be specified in the award document, and will include, as a minimum, monthly financial status reports and a yearly status summary. A final report that summarizes the project and tasks will be required at the conclusion of the performance period for the award. The reports shall be prepared and submitted in accordance with the procedures contained in the award document.

2. Representations and Certifications

In accordance with FAR 4.1201, prospective proposers shall complete electronic annual representations and certifications at http://www.sam.gov.

3. Wide Area Work Flow (WAWF)

Unless using another means of invoicing, performers will be required to submit invoices for payment directly at https://wawf.eb.mil. If applicable, WAWF registration is required prior to award under this solicitation.

4. i-Edison

Award documents will contain a requirement for patent reports and notifications to be submitted electronically through the i-Edison Federal patent reporting system at https://public.era.nih.gov/iedison.

VII. Agency Contacts

DARPA will use email for all technical and administrative correspondence regarding this solicitation.

- **Technical POC**: Dr. Predrag Milojkovic, Program Manager, DARPA/DSO
- **Solicitation Email:** EXTREME@darpa.mil
- **Solicitation Mailing Address:**

  DARPA/DSO
  ATTN: DARPA-BAA-16-58
  675 North Randolph Street
  Arlington, VA 22203-2114

- **DSO Solicitation Website:** http://www.darpa.mil/work-with-us/opportunities

VIII. Other Information

A. Frequently Asked Questions (FAQs)

Administrative, technical, and contractual questions should be emailed to EXTREME@darpa.mil. All questions must be in English and must include the name, email address, and the telephone number of a point of contact.

DARPA will attempt to answer questions in a timely manner; however, questions submitted within 7 days of the proposal due date may not be answered. DARPA will post an FAQ list at: http://www.darpa.mil/work-with-us/opportunities. The list will be updated on an ongoing basis until the BAA expiration date as stated in Part I.

B. Collaborative Efforts/Teaming

DARPA highly encourages teaming before proposal submission and, as such, will facilitate the formation of teams with the necessary expertise. Interested parties should submit a one-page profile including the following information:

- Contact information to include name, organization, email, telephone number, mailing address, organization website (if applicable).
- A brief description of the proposer's technical competencies.
- Desired expertise from other teams, if applicable.

All profiles must be emailed to EXTREME@darpa.mil no later than 3:00 PM (Eastern) on September 2, 2016. Following the deadline, the consolidated teaming profiles will be sent via email to the proposers who submitted a valid profile. Specific content, communications, networking, and team formation are the sole responsibility of the participants. Neither DARPA nor the DoD endorses the information and organizations contained in the consolidated teaming profile document, nor does DARPA or the DoD exercise any responsibility for improper

dissemination of the teaming profiles.

C. Proposers Day

The EXTREME Proposers Day will be held September 1, 2016 as a webcast. Advance registration is required. See DARPA-SN-16-62 posted at www.fbo.gov for all details. Attendance at the EXTREME Proposers Day or viewing the webcast is voluntary and is not required to propose to this solicitation.