



Research Announcement
Young Faculty Award (YFA)
Defense Sciences Office

DARPA-RA-18-02

August 9, 2018

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ATTACHMENT A: EXECUTIVE SUMMARY TEMPLATE

ATTACHMENT B: PROPOSAL TEMPLATE – TECHNICAL & MANAGEMENT VOLUME 1

ATTACHMENT C: COST BREAKDOWN TEMPLATE

ATTACHMENT D: PROPOSAL TEMPLATE – ADMINISTRATIVE & NATIONAL POLICY REQUIREMENTS VOLUME 3

ATTACHMENT E: PROPOSAL TEMPLATE SUMMARY SLIDE

ATTACHMENT F: COST VOLUME 2 (Optional)

PART I: OVERVIEW INFORMATION

- **Federal Agency Name:** Defense Advanced Research Projects Agency (DARPA), Defense Sciences Office (DSO)
- **Funding Opportunity Title:** Young Faculty Award (YFA)
- **Announcement Type:** Initial Announcement
- **Funding Opportunity Number:** DARPA-RA-18-02
- **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 9, 2018
 - Executive Summary Due Date: September 10, 2018, 4:00 p.m.
 - FAQ Submission Deadline: November 8, 2018, 4:00 p.m. See Section VIII.A.
 - Full Proposal Due Date: November 13, 2018, 4:00 p.m.
- **Anticipated Individual Awards:** Multiple awards are anticipated.
- **Anticipated Funding Available for Award:** Each award will include a 24-month base period (a maximum of \$500,000) and a 12-month option period (a maximum of \$500,000).
- **Types of Instruments that May be Awarded:** Grants.
- **Agency Contacts**
 - **RA Email:** YFA2019@darpa.mil
 - **RA Mailing Address:**
DARPA
ATTN: DSO/DARPA-RA-18-02
675 North Randolph Street
Arlington, VA 22203-2114
 - **DARPA/DSO Opportunities 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 DARPA/DSO Opportunities Website. See Section VIII.A for further information.

PART II: FULL TEXT OF ANNOUNCEMENT

I. Funding Opportunity Description

This Research Announcement (RA) constitutes a public notice of a competitive funding opportunity as described in 2 CFR § 200.203. Any resultant negotiations and/or awards will follow all laws and regulations applicable to the specific award instrument(s) available under this RA.

A. Introduction

The Defense Advanced Research Projects Agency (DARPA) Young Faculty Award (YFA) program aims to identify and engage rising stars in junior faculty positions in academia and equivalent positions at non-profit research institutions and expose them to Department of Defense (DoD) and National Security challenges and needs. In particular, this YFA will provide high-impact funding to elite researchers early in their careers to develop innovative new research directions in the context of enabling transformative DoD capabilities. The long-term goal of the program is to develop the next generation of scientists and engineers in the research community who will focus a significant portion of their future careers on DoD and National Security issues. DARPA is particularly interested in identifying outstanding researchers who have previously not been performers on DARPA programs, but the program is open to all qualified applicants with innovative research ideas.

Before preparing an executive summary or proposal submission, proposers are encouraged to review the DARPA mission statement and current program descriptions at the DARPA website <https://www.darpa.mil> to familiarize themselves with examples of current DARPA investments. This is not meant as instruction to duplicate those efforts, but rather to illustrate that current programs are aimed at research that will substantially advance our capabilities in these areas. Once awards are made, each YFA performer will be assigned a DARPA Program Manager with interests closely related to their research topic. The Program Manager will act as project manager and mentor to the YFA award recipients.

Proposers should also familiarize themselves with the “Heilmeier Catechism.” Details about the catechism and questions it seeks to answer can be found at <https://www.darpa.mil/work-with-us/heilmeier-catechism>.

B. Program Description/Scope

DARPA is soliciting innovative research proposals in the areas of interest to DARPA’s six technical offices: Biological Technologies Office (BTO), Defense Sciences Office (DSO), Information Innovation Office (I2O), Microsystems Technology Office (MTO), Strategic Technology Office (STO), and Tactical Technology Office (TTO). Further detail regarding the specific technical areas of interest can be found under Section I.E “Topic Areas (TAs).” Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

Submissions responding to this RA should clearly describe the DoD problem being addressed, the current state-of-the-art technology, new insights to address the problem, a credible research plan and schedule, and critical, quantitative milestones to be pursued over the research period. This RA seeks grant proposals only. Submissions for any other award instrument type may be considered non-conforming with the RA and may not be reviewed.

C. Program Structure

This RA seeks grant proposals for a research activity consisting of a 24-month base period. Each 12-month interval of the base period should not exceed \$250,000. Proposals should also include a 12-month option period with a maximum funding level of \$500,000. The 12-month option period, referred to as the “Director’s Fellowship,” will be reserved for a limited number of awardees who demonstrate exceptional YFA project performance over the 24-month base period. A target start date of July 2019 may be assumed for planning purposes.

As part of the program, a number of visits/exercises at a variety of DoD sites and facilities will be scheduled. These briefings and visits will provide YFA recipients a unique, first-hand exposure to DoD personnel and technologies in the field, issues faced by the Military Services in execution of their missions, and current National Security challenges. It is expected that YFA recipients will participate in a subset of the visits/exercises made available to them. Participation in all such opportunities is not a requirement; however, lack of participation may impact the award of the Director’s Fellowship. Proposers are expected to include the necessary travel funds within the total budget of their proposal. For budgeting purposes, please plan for a minimum of 6 two-day meetings (three meetings in the Washington, D.C. area and three meetings in the San Francisco, CA area). Of the six meetings, four should occur over the course of the 24-month base period and two over the course of the 12-month option period.

D. Eligibility

Participation in the YFA program is limited to any current tenure-track Assistant or Associate Professors and to tenured Assistant or Associate Professors within three (3) years of their tenure appointment at a U.S. institution of higher education or equivalent at a U.S. non-profit science and technology research institutions. Proposals are not being sought from foreign organizations; however, foreign organizations may be a member of a team in a subcontractor role. Previous YFA recipients are not eligible to apply to this or any future YFA program. Please see Section III for more details.

E. Topic Areas (TAs)

This RA solicits single principal investigator (PI) proposals for research and development in the specific TAs of interest articulated below. Prior to submitting a full proposal, proposers are *strongly encouraged* to first submit an executive summary as described in Section IV. At the executive summary phase, proposing PIs are limited to one executive summary per TA; at the full proposal phase, proposing PIs are limited to submitting only one full proposal to only one topic under this RA. Submitting more than one full proposal may result in all of the PI’s proposal submissions being determined non-conforming and being removed from award consideration.

Potential applicants are encouraged to carefully consider the descriptions of the TAs before submission. Each submission (executive summary or full proposal) must specify ONE and only one TA for the submission and identify this TA on the submission's cover sheet. Executive Summaries and Full Proposals (limit of one proposal per proposer) that do not clearly address a specific topic may be deemed non-conforming and may not be reviewed. DARPA reserves the right to assign a proposal or an executive summary to a different topic area than indicated by the proposer.

Technical inquiries should be emailed to YFA2019@darpa.mil with the TA stated in the subject line. Your question will be distributed to the appropriate contact. Please see Section VIII.A for more details regarding the question and answer process.

1. Biologically inspired GPS-denied navigation

Despite extensive use of Global Positioning Systems (GPS) for navigation, the ability to accurately geolocate over long timescales (days to months) represents a challenge in the deep-sea environment and other locations that lack access to satellite signals. Investigations into non-satellite based navigation technologies that use electromechanical techniques show promise, however, most do not use nature as their inspiration. Instead, these techniques rely on high precision sensors and/or feature-based localization. Marine biological organisms, many of which have evolved natural navigation techniques over millions of years, can provide insight into new ways of navigating through the ocean for manned and unmanned underwater vehicles. For example, marine organisms may use one or several types of sensory organs for navigation, including olfactory, electromagnetic, magnetosensory, and optical (specifically, polarization of light). This topic seeks concepts for bio-inspired and biomimetic GPS-denied navigation concepts amenable for use in the marine environment.

2. Enhancing Prophylactic Immunity and the Immune Response

This topic seeks innovative proposals that would leverage bioelectronic medicine to enhance the immune response or prophylactic immunity in response to biological threats. Recent advances in peripheral nerve stimulation enable neuromodulation of peripheral nerves to regulate organ and organ system physiology. DARPA seeks innovative proposals that would leverage bioelectronic medicine to enhance the immune response or prophylactic immunity in response to biological threats or to prepare the warfighter for situations where infection risk will be higher. Proposers should explicitly address how their proposed approach would boost the immune response to a given pathogen or how the approach would prime the immune system to heightened prophylactic reactivity without detriment to basal conditions. Proposals should include a component wherein appropriate biomarkers will be identified as a means to verify the correct type and level of enhanced immune response. Work should be performed in relevant animal models with a realistic translation plan to human populations and conditions. It is expected that the developed techniques will lead to precise, safe, and effective means to enhance immune system function through modulation of peripheral nerves or target tissues and organs.

3. Plant Bio-mining System

The aim of this topic is to support the military supply chain by optimized bio-acquisition of strategic minerals critical to national security. For example, the majority of rare earth elements are collected from mining operations and then processed and refined outside of the United States at commercial scale. However, rare earth elements commonly occurring in soil and plants naturally collect and concentrate in a process termed phytoextraction. Recent discoveries show plants' phytoextraction efficiencies differ among species and highlight potential mechanisms for improved implementation. DARPA envisions optimizing plant systems to actively bio-mine strategic minerals (e.g., rare earth elements) through phytoextraction. General strategies could include increasing the levels of critical and strategic minerals to more easily extractable plant organs and improving extraction and plant processing practices compatible to downstream uses.

4. Bioaccelerants

This topic is searching for new approaches to selectively accelerate protein synthesis as a novel therapeutic to speed tissue recovery and improve physiological plasticity without introducing genetic modifications or relying on ectopic protein expression. Protein synthesis is one of a few core components of life at the molecular level; it is also the factor that sets the upper limit for many physiological processes, such as the generation of new memories, the construction and repair of body tissues, and immune responses to disease. At a fundamental level, building a protein is the act of turning information into function, by virtue of translating a nucleic acid polymer blueprint into a peptide polymer workhorse. The biochemical machinery that governs the rate, subcellular location, and extent of new protein synthesis is a tightly regulated, multicomponent system that is full of redundancies and Achilles heels. Some of these weak points have been previously exploited for therapeutic benefit by selectively shutting off protein synthesis in pathogenic organisms while sparing the process in mammalian cells (e.g., aminoglycoside antibiotics), but exploration of protein synthesis facilitation is a neglected area of investigation. Chemical biology techniques that explore the druggable space of the protein synthesis apparatus and its state-dependent regulation are of particular interest.

5. Quantum inspired classical optical computing

Recently experiments have demonstrated Bell inequality violations in classical experiments blurring the quantum-classical boundary. This begs the question as to how one might inform classical optical experiments to mimic some or all of the characteristics so frequently sought and cited in quantum experiments. Classical experiments might be easier to perform but still permit some of the perceived advantages of quantum cryptography or computing to be realized. It might not be necessary that "high quality entanglement" is needed between separate particles or between different properties of the same particle. Exploring this possibility might further inform us about the deeper and more fundamental properties of light and light-matter interactions. Note that classical fields in two or more spatial dimensions are assumed to be irreducible functions. Their correlations and coherence properties may be considered to be entangled in a some sense. Irreducibility properties have provided justification for uniqueness arguments to prevail in scattering and imaging applications.

The goal of this topic is explore what quantum phenomena such as entanglement, non-locality, and discord can advance our understanding and interpretation of classical light. What current quantum properties or characteristics can be reproduced by classical physical optics? Relationships between Schroedinger's equation and the paraxial wave equation or the time independent Schroedinger equation and Helmholtz' equation may be informative. Are there light-matter interactions that can exploit classical entanglement for information processing? Of particular interest are quantum concepts that map to classical systems in complex media and provide new computational capabilities.

6. The Biology of Team Performance

Military mission success depends on team performance. However, teaming approaches that focus solely on individual cognitive and/or physical capabilities often fail to explain why some teams perform better than others. This topic aims to explore potential biological mechanisms – microbial, neurobiological, hormonal, and/or others - through which biology may influence factors important for team performance, such as cohesion, adaptability, resilience, leadership, trust, and social cognition, for complex environments and tasks.

Emphasis should be placed on identifying plausible biological mechanisms of team performance, since mechanisms identified under this topic could become intervention points for future research to improve teaming. Work might include approaches for mining existing literature, proposing mechanistic models derived from research, developing simulations to help quantify potential effect sizes of various biological mechanisms on team performance, and – if appropriate –conducting experimental work. Finally, this topic is specifically focused on teams where individuals are working deliberately together towards a common goal, which may change depending on the environment. General research into collective behavior is out of scope. Therefore, if animal models or literatures are proposed, justification should be included to explain why that model is appropriate for improving our understanding of the biology of team performance and its relevance to the DoD.

7. Smart City Sensing for Chemical and Explosive Threat Detection and Identification

Smart city sensor platforms now offer day-to-day value by continuously monitoring quantities that affect the quality of life such as noise and air quality. It is anticipated that such platforms will be increasingly deployed and will continue to grow in capability through the incorporation of emerging sensor technology and the availability of substantial local computational resources. This topic is interested in examining the use of existing smart city platforms for compact, high sensitivity (~ppb-level or better), and high selectivity sensors for the detection and identification of chemical and explosive weapons of mass destruction (WMD) threats, with the system providing overall situational awareness and understanding of the diverse chemical backgrounds in complex urban areas. Understanding the backgrounds of a broad range of relevant chemical species and precursors that exist in urban areas would maximize the ability to detect anomalous signatures, such as those emitted by production of WMD threats, in order to enable interdiction prior to an attack. The data-rich nature of the platform can provide critical context (e.g., video or

meteorological data) for the interpretation of chemical sensor data and provide the infrastructure to run advanced analytical techniques and algorithms. Analytical results are expected to be further enhanced through the incorporation of the node information into larger sensor networks such as DARPA's SIGMA+ network. Of specific interest are approaches that use an existing smart city sensor platform deployed within a complex urban environment, incorporate ppb-level sensitive chemical sensors, fuse relevant context information, and can communicate with the SIGMA+ network.

8. Bio-inspired modeling of resilience and efficiency in complex systems

Collective behavior in biological systems, such as cooperation and competition, spans the activities of a wide variety of species (bacteria, insects, fish, birds, mammals). These species demonstrate not only coordinated behavior, but also “sociality” - the result of an evolutionary process that selected species that coped with complex, dynamic, and uncertain environments by balancing group success and individual survival.

Biological systems are already a source of inspiration for computer science - slime molds efficiently compute NP-hard problems; new imaging techniques that reveal the neuronal structures of systems like *Drosophila* have led to machine learning algorithms that out-perform human-engineered approaches. However, the collective, or “social” behavior of biological systems remains relatively unexplored, despite new opportunities to observe and analyze .

This topic explores this utility by focusing on the interaction between two tractable dimensions – physical movement (e.g., transportation of food, responding to a threat) and communication. Successful proposals will apply current and next-generation technologies for sensing, learning, and computationally model individual entities (e.g., modeling ant response to alarm signals; monitoring and representing the behavior economics of bacteria) to better understand and exploit the potential of socio-biological systems. The effort must address one or both of the following areas: (1) Sensing and sensor-processing of socio-biological systems (e.g., achieve orders-of-magnitude improvements in the number of socio-biological entities that can be accurately and precisely tracked; automatically identify and analyze behavioral features; demonstrate and quantify results across at least two species); (2) Computational modeling of socio-biological systems (e.g., derive and/or learn algorithms, models, and causal mechanisms; validate these across at least two species; demonstrate improvements over existing theories of complex system behavior). Across both objectives, an evaluation of the application to national security contexts is required. Critically, any approach must include a plan to quantitatively describe and demonstrate the improvements over the state of the art obtained through the study of socio-biological systems

9. Quantifying Software Vulnerability Longevity

The persistent existence of vulnerable systems is a critical cybersecurity issue for the DoD. This effort looks to develop rigorous, data-driven models that quantify the rate of change of a system's software over time. For example, if a specified system has a software version X today, what is the likelihood that the same system will have that same software version three months from now? In order to try to obtain system-level prediction, two different factors will likely have

to be examined: (1) a global assessment of how particular kind of software is changed (e.g., via the software update cycle); and (2) how individual or organizational factors affect system updates (possibly assuming a global model for software rate of change). The scope of this effort may be restricted to particular classes of systems or software; of particular interest are industrial control systems and other software and systems that, due to operational necessities, are often patched less frequently. Proposers should discuss the data sources that they will either have access to or need in order to conduct this research; if they do not currently have access to needed data, they should discuss how they plan to either get access or take alternative steps if they cannot get access. Specifically, not in scope for this effort is research that does not attempt to be quantitatively predictive.

10. Hybrid Intelligent Agents

Machine learning has been successful for specific classes of problems, but requires extensive training datasets that can be challenging to obtain for complex, unstructured problems. Recent research has shown that realtime crowdsourcing can provide human insight to assist Artificial Intelligence (AI) when limited training data is available, allowing these systems to work reliably even in novel scenarios. This topic seeks the development of Hybrid Intelligent Agents that use AI algorithms supplemented with crowdsourced human inputs to learn in settings where AI currently fails or underperforms. Specific areas of interest include ontology requisition and matching, domain-agnostic National Language Processing (NLP) (addressing issues such as complex coreferencing, table reading, and figure understanding), knowledge assembly and querying, model specification and parameterization, model execution and evaluation, and integration of qualitative and quantitative inputs in rich explanations. The goal is to help formalize and solve broad classes of complex high-dimensional problems in cases where training data is sparse or unavailable. DARPA is specifically interested in approaches that scale and efficiently combine input from both large general crowds and small expert crowds.

11. Complete Logic Erasure And Recovery (CLEAR)

Malicious cyber actors aim for both penetration of computer and network defenses and persistence once they are breached; persistence enables the adversary to choose when to act. The research effort in this topic is directed at trustworthy recovery from one or more adversarial implants in a computer. For an approach to be trustworthy, it must guarantee that the threat is eliminated, and that the computer is recovered to a usable state. Novel approaches to complete erasure that are of interest for this topic include comprehensive hardware discovery and bus mapping by a trusted sideboard, sanitization of the computer, including emerging approaches to eliminating state in analog circuitry such as Static random-access memory (SRAM) remanence, use of and remote access to a trusted repository of cryptographic integrity checksums by the sideboard, a secure bootstrap process with recovery that employs the sideboard as a hardware root of trust, and the design of trusted firmware and software repositories with secure access protocols to maintain the integrity of the recovery process. A prototype implementation is desirable/expected, should include a demonstrable recovery sideboard and prototype software released as open source.

12. Validating Type Consistency of Semi-Structured Data

As software systems grow in complexity, there is an increased motivation for their infrastructure architecture to be codified as part of their source code base. Scripting languages (e.g., bash, python, LUA, etc.) and configuration management tools (e.g., Chef, Puppet, Teraform, etc.) have grown into a larger portion of a software system's source as not only the software, but also the infrastructure and deployment architectures, are stored in software repositories. This configuration and infrastructure code is typically less structured than statically-typed programming languages, and the validation may commonly be delayed until runtime, resulting in failures that are more difficult and costly to prevent. Proposals should focus on using novel algorithmic techniques to infer and validate the types, syntax, and other semantics of these semi-structured data files in order to reduce the runtime error rates of complex software systems.

13. Device-centric Detection of Security and Privacy Attacks Against Cellular Networks

A cellular network, which is an integral part of a nation's critical infrastructure, not only influences our society as a whole (e.g., dissemination of public-safety messages) but also can impact us at a more personal level by enabling innovative applications that improve the individual's quality of life (e.g., cloud-backed hearing aids). Vulnerabilities in such a critical network, as demonstrated by the widespread International Mobile Subscriber Identity (IMSI) catcher attacks, can be used to mount targeted and widespread security and privacy attacks that can become a matter of national security. The impacts of such vulnerabilities are further exacerbated due to recent proposals that Internet-of-Things (IoT) devices, wearable devices, unmanned aerial vehicles, and self-driving automobiles communicate over the cellular network. Proposals in response to this topic should focus on developing extensible and principled approaches that will empower cellular devices and their users to detect active attack attempts on the devices from the perspective of cellular protocol (i.e., 2G/3G/4G LTE) and provide feedback regarding the threat levels and remedial actions that can thwart the ongoing (security and privacy) attacks.

14. Instinctual Radio Frequency (RF) Adaptive Circuits, Devices & Materials

For multi-user communications networks in crowded electromagnetic environments, unintentional interference can significantly degrade the performance of radios. This has typically been managed through pre-planned spectral management and fixed-frequency filtering. With the increased use of high-performance software-defined digital radios, techniques such as MUSIC (Multiple Signal Classification), MUD (Multi-User Detection) and emerging machine learning algorithms are being applied to help manage this interference. However, these techniques rely on learning the subtle differences between the desired signal and the interference which requires time and digital compute resources. This topic seeks innovation in Instinctual RF Adaptation to be able to react quickly in an instinctual and unlearned manner to RF interference. It is expected that some discriminating feature such as power level, frequency band, bandwidth, phase or other signal statistic could be used to tune a circuit, device or material property to reduce the interference very near the RF front-end of the radio. Classic examples of components that exhibit these types of properties are frequency selective limiters (FSL) and instantaneous

frequency measurements (IFM). In some cases, these components are implemented with clever circuit design, but in other cases material properties may be leveraged (multiferroic, piezoelectric, etc). Specifically, the topic seeks innovation in widely tunable circuits, devices or materials that can instinctually tune themselves to reduce interference near the input of digital radio systems.

15. New Materials for Efficient Nonlinear Integrated Photonics

This topic seeks the development and demonstration of highly-efficient nonlinear integrated photonics tailored to defense critical applications, with an emphasis on new materials integration. Bulk nonlinear components are vital elements of numerous optical systems, and the development of chip-scale components with efficiencies on-par or beyond that of bulk components will find broad utility if easily integrated within existing photonics platforms. Integrated photonics is an enabling technology for many DoD and commercial applications, including computing, communications and sensing. However, investment in the technology has typically emphasized linear photonics, while chip-scale nonlinear functionality has only recently begun to be explored. Nonlinear effects in low-loss silicon nitride have been successfully employed in chip-scale devices, particularly for supercontinuum generation and optical frequency combs. However, while silicon nitride is anticipated to remain critical to future chip-scale photonics systems, the incorporation of alternative materials with stronger nonlinearities holds the promise of higher efficiencies and new functionality. DARPA seeks to explore new nonlinear materials and unique device structures on an integrated platform that will create a pathway for new directions in chip-scale nonlinear optics. Successful proposals will describe their material and device concepts, fabrication and characterization plans, and should include clear device target metrics for the proposed components as well as a description of the benefits to a target application.

16. Multi-Functional Materials for Additive Manufacturing

With increased interest in additive manufacturing for rapid prototyping, field repairs, and exploration of innovations across many engineering disciplines, there is a growing need to increase the diversity of the materials available to the designer. Moving beyond plastics and metals as well as insulators and conductors, adding multi-functional materials to the additive manufacturing construct is compelling. Multi-functional materials could enable smart materials assemblies where structural components might incorporate strain response materials to generate power, increase stiffness during vibration or impact events, or change thermal conductivity to an external stimuli. This topic seeks innovation in materials engineering and integration approaches to bring advancements in multi-functional materials into the realm of additive manufacturing. Emphasis should be on synthesis and integration approaches that extend the existing list of materials common to additive manufacturing. For example, high performance strain response materials such as piezoelectrics or shape memory alloys are of interest. Desired performance metrics should emphasize the multi-functional aspect of the innovation, (e.g., strain generation as a function of voltage, power output as a function of vibration input, stiffness change with vibration, etc.) and compare those with their conventional material counterparts.

17. Integrating Infrared Devices on Substrates with Low Dislocation Densities Using Low-Cost Fabrication Technologies

New techniques are emerging that enable DoD devices, especially infrared (IR) photodetectors, made from novel epitaxial materials to be fabricated using conventional wafer technology. Doing so vastly simplifies chip and module production and reduces the cost of wafer technology for DoD systems. The challenge is that many epitaxial films used by DoD have a crystalline lattice that is mismatched to that of silicon. This topic seeks to develop material growth techniques that fabricate high-quality device structures across entire low cost, large diameter, commercially available substrates using epitaxial layers with a large lattice mismatch to an underlying substrate. Past attempts to grow devices using metamorphic techniques demonstrated material defect densities that are too high to meet required performance beyond about 4% mismatch.

The focus of this topic is to develop IR detector devices that enable DoD systems to be easily integratable using low-cost approaches. This topic seeks to grow single-crystal IR devices on material systems with lattice mismatches significantly beyond current state of the art. Defect density should be shown to be uniform across a large-diameter substrate. Proposers should identify their approach, material systems, bandgaps compatible with IR wavelengths, relevance to DoD systems, and clearly articulate how the material defect densities will be characterized. Proposers should detail how their approach advances beyond the state-of-the-art lattice mismatches and overcomes current integration challenges.

18. Compact Planar Ultra broadband Array Antenna

The electromagnetic Radio Frequency (RF) spectrum in the field is congested with multiple frequency bands for both civilian and military operations. Often multiple narrow band antennas are needed to cover a wide frequency spectrum, which are very bulky and difficult to operate in the mobile environment. A single compact planar broadband array antenna would provide a small radio footprint to enable broadband operations for sensors, RF receivers, and electronic warfare systems for current and future military communications. This topic seeks to develop and demonstrate a compact planar ultra broadband array antenna operating from 1 GHz up to 100 GHz, which is needed to interface with emerging ultra broadband electronic integrated circuits with 100GHz instantaneous bandwidth.

This topic focuses on new design and realization of a planar antenna element to provide modest gain with an operational bandwidth covering from 1 GHz up to 100GHz with good matching and low return loss to the impedance of RF feeding port, typically 50 ohms. Multiple compact planar antenna elements should be integrated together to form a planar phased array antenna with element-to-element spacing of a half wavelength of the highest frequency of operation with minimal grating lobes in the radiation pattern. Implementations using either passive elements or integration enhanced by active integrated electronics are encouraged.

19. Non-foster Circuit Synthesis

Design of electronic systems are guided by circuit synthesis techniques with lumped parameter “foster” circuits. These foster circuits are inherently stable, this making them the dominant way modern electronics are created. However, non-foster circuits are also possible, and hold the promise of revitalizing the field of circuit synthesis. The goal would be to exceed performance bounds by orders of magnitude. The challenge is that non-foster circuits rely on active electronics to create capacitance and inductance. This reliance makes them inherently unstable. New non-foster models are required to understand in detail the poles and zeros of the electronic components and circuits. These models will enable system designers to ensure both performance and stability. Work under this topic could include the use of non-foster matching circuits to increase antenna efficiency or bandwidth, in particular for electrically short High Frequency (HF) antennas.

20. Integrated Analog Photonics

Analog photonics, commonly termed microwave photonics, is a growing field despite the advances in digital signal processing. An emerging technology for microwave photonics is the photonic integrated circuit (PIC). The vast majority of work in PICs is application-specific. This topic focuses on revolutionary concepts and technologies towards generic PICs with widespread applicability for analog signal processing. The goal is to develop and demonstrate PICs that exhibit a high degree of configurability to afford numerous functionalities from a single chip. A good example of this approach comes from the electronics community, where field-programmable gate arrays have largely replaced application-specific integrated circuits. Hybrid material platforms to this end are encouraged and the developed PICs should be compatible with a fiber-based infrastructure. Use cases of the new PIC technology should also be considered.

21. Learning to Become Skilled at Tasks

It is well-documented that biological systems get faster at a specific task with longer training – a seasoned analyst will have a much faster reaction time than a novice. Current machine learning research such as deep neural networks mostly focuses on making a learning system progressively perform better as it sees more and more data. Little or no attention is paid to making the system perform faster via learning. Consequently, current machine learning systems depend on hardware progress to achieve the runtime computation needed in time-critical tasks. This topic seeks foundational mechanisms, new machine learning architecture designs, training paradigms, and hardware architectures to enable machine learning systems to become skilled in performance as well as in execution via continuous learning.

22. Predictive Vision

This topic seeks new machine learning paradigms that focus on the predictive role of perception in a dynamic environment, inspired by research in neuroscience. It is hypothesized that perceptual processing in the neural circuits of a biological system is wired to infer and encode the states of its environment and to anticipate changes in the continuum of scales in time and

space. Perceptual constructs such as object categorization, scene and event recognition are byproducts of the process rather than its elemental functional objectives. This stands in contrast to the current, de-compositional, discrete specialization paradigms of taken by the machine learning community. This suggests new venues to explore machine learning architectures. Successful proposals will focus on techniques to mimic several important visual perception behaviors exhibited by living organisms, including fast reflex, intuition, intent anticipation, and time efficiency. Particular emphases should be placed on the computational mechanisms underlying this predictive role in perception and algorithm architectures that may realize this predictive architecture for machine learning applications.

23. Assessing the Reliability of Structural Systems Undergoing Intense Multi-Physics Loading Typical of Sustained Hypersonic Flight

The hypersonic flight regime is the harshest of in-atmosphere flight environments, demanding aerospace analysts and designers take structural and material systems to their limits. Efficient hypersonic flight vehicles require the optimization of the structural mass fraction, which can only be achieved through understanding, with high confidence, the interactions between the vehicle performance/trajectory, the details of the structural configuration, and the material systems employed to create the structure. Perhaps most important is the connection between the material system or systems employed in the structure and the structural response to the applied loads. This effort must target advances in one or more of the following categories to enable meaningful advances towards the required understanding of material-structural behavior: (1) the development of algorithms to establish the coupled structural-material margins for typical hypersonic mission trajectories; (2) processes to optimize the generation of atypical material property databases necessary for hypersonic systems; and/or (3) a numerical framework to optimize hypersonic vehicle structures given specialized, but limited, material system data (e.g., that derived from (2) above). The resulting framework and/or the material dataset(s) developed must account for manufacturing variability, component-to-assembly/sub-structuring considerations, and the sensitivity of this framework to having only a limited or incomplete material property database.

24. Health Monitoring of High Speed Propulsion Systems

In emerging propulsion systems for reusable hypersonic aircraft systems such as turbine-based combined cycle engines (TBCCs), health management for relatively low cycle life structure (fixed and variable) will drive both flight risk (safety) and operational cost (inspection, repair, and replacement). The fidelity of life cycle analysis under combined loads (mechanical, thermal, and acoustic) yields significant uncertainty due to variations in loads and nonlinear response. This is difficult to engineer around when the number of load cycles is more than one, such as in expendables, and when the number of load cycles is much less than conventional aircraft, where the cycles add up to thousands of flight hours, and inspections can fill the uncertainty in life prediction. This topic seeks innovations in health management for TBCCs that can capture damage mechanisms and, in concert with uncertainty in life prediction methods, prevent in-service failures and minimize maintenance consistent with limited life requirements (100s of hours versus 1000s).

25. Dynamic Network Modeling for On-orbit Servicing, Assembly, and Manufacturing

On-orbit servicing, assembly, and manufacturing (OSAM) are emerging as key domain areas for future development to support U.S. Government, commercial, and exploration space missions. This topic seeks innovative ideas for dynamic modeling tools for OSAM and associated operations. Dynamic network modeling of space logistics for Earth-orbiting spacecraft is of particular interest because of the cost, resource, and time constraints that dominate the allocation of launches, resupply materials (e.g., fuel, parts, construction material), and operations scheduling. The development of robust yet flexible models of space infrastructure and associated traffic management for launch, orbit adjustment, servicing/assembly/manufacturing sorties, etc. will benefit both government and commercial interests and can serve as a platform for both strategic concept development and more tactical near-term operations planning.

II. Award Information

A. General Award Information

DARPA anticipates multiple awards.

The level of funding for individual awards made under this RA will depend on the quality of the proposals received and the availability of funds. Awards will be made to proposers¹ whose proposals are determined to be the most advantageous to the Government, all evaluation factors considered. 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 awards 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.

¹ As used throughout this RA, “proposer” refers to the lead organization on a submission to this RA. The proposer is responsible for ensuring that all information required by a RA--from all team members--is submitted in accordance with the RA. “Awardee” refers to anyone who might receive a prime award from the Government. “Subawardee” refers to anyone who might receive a subaward from a prime awardee (e.g., subawardee, consultant, etc.).

Proposals identified for negotiation may result in a grant.

In all cases, the Government contracting officer shall have sole discretion to select award instrument type, regardless of instrument type proposed, and to negotiate all instrument terms and conditions with selectees. DARPA will apply publication or other restrictions, as necessary, if it determines that the research resulting from the proposed effort will present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Any award resulting from such a determination will include a requirement for DARPA permission before publishing any information or results on the program. For more information on publication restrictions, see the 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 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 RA, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research and does not anticipate applying publication restrictions of any kind to individual awards for fundamental research that may result from this RA. 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 RA 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 determine whether the proposed research shall be considered fundamental. Appropriate clauses will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate. This clause can be found at www.darpa.mil/work-with-us/additional-baa.

For certain research projects, it may be possible that although the research to be performed by a potential awardee is restricted research, their subawardee’s effort may be fundamental research.

In those cases, it is the awardee's responsibility to explain in their proposal why its subawardee's effort is fundamental research.

III. Eligibility Information

A. Eligible Applicants

Participation is open to individuals who are U.S. Citizens, U.S. Permanent Residents, and Foreign Nationals who meet the eligibility criteria listed below:

- Proposers must be one of the following (excluding any personal leaves of absence) by the full proposal deadline listed in Part One: Overview Information:
 - current Tenure-Track Assistant/Associate Professors;
 - current Tenured faculty within 3 years of their Tenure date; or
 - an equivalent at a non-profit research institution within 12 years of the receipt of their Ph.D.
- All proposers must be employed at a U.S. Institution.
- Previous YFA recipients are not eligible for this or any future, YFA program.
- Former DARPA Program Managers are not eligible to apply for funding under this program.
- Researchers working at Federally Funded Research and Development Centers, DoD and other Government Laboratories are not eligible to apply as PIs for funding under this program; however, they may be proposed as subsawardee – please see Section VIII.B on teaming.
- Non-U.S. 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. See Section III.A for more information.
- At the executive summary phase, proposing PIs are limited to one executive summary per TA. At the full proposal phase, proposing PIs are limited to submitting only one full proposal to only one topic under this RA. Submitting more than one full proposal may result in all of the PI's proposal submissions being determined non-conforming and being removed from award consideration. A proposer is strongly encouraged to submit an executive summary in advance of a full proposal to determine DARPA's interest and minimize the effort and expense of preparing an out of scope proposal.
- Recipients of non-YFA DARPA awards are eligible to propose. Proposers must provide a listing of federal support (past, current, and pending). This list must include the sponsor, amount, and performance dates of all federally-funded research efforts and should be present on the submission cover sheet as indicated in Section IV.

There is no limit to the number of applications that can be submitted by an institution; however, each submission must have a single PI. Submissions to young investigator programs sponsored by other agencies are not restricted.

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

a. FFRDCs

FFRDCs are subject to applicable direct competition limitations and cannot propose to this RA 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 awardees or subawardees. Under YFA, FFRDCs are not eligible to propose as PIs; however, they may be proposed as subs.

b. Government Entities

Government entities (e.g., Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations. 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. This information is required for Government Entities proposing to be awardees or subawardees. Under YFA, Government/national laboratories are not eligible to propose as PIs; however, military education institutions are welcome to submit proposals as PIs. All Government Entities may be proposed as sub-awardee.

c. Authority and Eligibility

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/individuals proposed as a subcontractor on a team and/or Non-U.S. individuals who are employed by a U.S institution 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. For classified

submissions, this includes mitigating any Foreign Ownership Control and Influence (FOCI) issues prior to transmitting the submission to DARPA. Additional information on these subjects can be found at http://www.dss.mil/isp/foci/foci_faqs.html.

B. Organizational Conflicts of Interest (OCI)

FAR 9.5 Requirements

In accordance with FAR 9.5, proposers are required to identify and disclose all facts relevant to potential OCIs involving the proposer's organization and *any* proposed team member (subawardee, consultant). Under this Section, the proposer is responsible for providing this disclosure with their proposal submitted to the RA. The disclosure must include the proposer's, and as applicable, proposed team member's OCI mitigation plan. The OCI mitigation plan must include a description of the actions the proposer has taken, or intends to take, to prevent the existence of conflicting roles that might bias the proposer's judgment and to prevent the proposer from having unfair competitive advantage. The OCI mitigation plan will specifically discuss the disclosed OCI in the context of each of the OCI limitations outlined in FAR 9.505-1 through FAR 9.505-4.

Agency Supplemental OCI Policy

In addition, DARPA has a supplemental OCI policy that prohibits contractors/performers from concurrently providing Scientific Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS) or similar support services and being a technical performer. Therefore, as part of the FAR 9.5 disclosure requirement above, a proposer must affirm whether the proposer or *any* proposed team member (subawardee, consultant) is providing SETA, A&AS, or similar support to any DARPA office(s) under: (a) a current award or subaward; or (b) a past award or subaward that ended within one calendar year prior to the proposal's submission date.

If SETA, A&AS, or similar support is being or was provided to any DARPA office(s), the proposal must include:

- The name of the DARPA office receiving the support;
- The prime contract number;
- Identification of proposed team member (subawardee, consultant) providing the support; and
- An OCI mitigation plan in accordance with FAR 9.5.

Government Procedures

In accordance with FAR 9.503, 9.504 and 9.506, the Government will evaluate OCI mitigation plans to avoid, neutralize or mitigate potential OCI issues before award and to determine whether it is in the Government's interest to grant a waiver. The Government will only evaluate OCI mitigation plans for proposals that are determined selectable under the RA evaluation criteria and funding availability.

The Government may require proposers to provide additional information to assist the Government in evaluating the proposer's OCI mitigation plan.

If the Government determines that a proposer failed to fully disclose an OCI; or failed to provide the affirmation of DARPA support as described above; or failed to reasonably provide additional information requested by the Government to assist in evaluating the proposer's OCI mitigation plan, the Government may reject the proposal and withdraw it from consideration for award.

C. Cost Sharing/Matching

Cost sharing is not required.

IV. Application and Submission Information

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

- The proposed concept is applicable to the technical and topic areas described herein;
- The proposed concept is important to DARPA'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);
- The proposer must meet the eligibility requirements outlined in Section III; and
- Only requests for grants may be considered.

Executive summaries and full proposals that are not found to be applicable to the YFA RA as defined above may be deemed non-conforming² and removed from consideration. All executive summaries 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. Executive summaries 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.

² "Conforming" is defined as having been submitted in accordance with the requirements outlined herein.

B. Content and Form of Application Submission

1. Executive Summary Information

As stated above, proposers are strongly encouraged to submit an executive summary in advance of a full proposal to minimize effort and reduce the potential expense of preparing an out of scope proposal. DARPA will respond to executive summaries with a statement as to whether DARPA is interested in the idea. Regardless of DARPA's response to an executive summary, proposers may submit a full proposal. DARPA will review all conforming full proposals using the published evaluation criteria (See Section V.A) and without regard to any comments resulting from the review of an executive summary. Proposers should note that a favorable response to an executive summary is not a guarantee that a proposal based on the executive summary will ultimately be selected for award negotiation.

Executive summaries submitted in response to this solicitation may anticipate a response within approximately 30 calendar days. These notifications will be sent via email to the Technical POC and/or Administrative POC identified on the executive summary coversheet.

Proposing PIs are limited to one executive summary per TA. Proposers are encouraged to carefully consider the descriptions of the TAs before submission. Each executive summary submission must specify ONE and only one of these TAs for their submission and identify this TA on the submission cover sheet. Executive summaries that do not clearly address a specific topic may be deemed non-conforming and may not be reviewed. DARPA reserves the right to assign executive summaries to a different topic area than indicated by the proposer.

Executive summaries must not be submitted to DARPA via email. See Section IV.E.1.a for executive summary submission instructions.

a. Executive Summary Format

All proposers are required to use the template provided as Attachment A to this solicitation on www.fbo.gov and <http://www.grants.gov>.

2. Full Proposal Information

Full proposals requesting a grant must use the following Attachments in addition to the Grants.gov application package. Complete full proposals consist of Attachment B: Proposal Template - Technical and Management Volume 1, Attachment C: Cost Breakdown Template, Attachment D: Proposal Template - Administrative and National Policy Requirements Volume 3, and Attachment E: Proposal Template summary slide. Attachment F: Proposal Template Cost Volume 2 (Optional).

*Note – Budget Justification should be provided as Section L of the SF 424 Research & Related Budget form provided via Grants.gov. The Budget Justification should include the following information for the recipient and all subawardees: (1) Direct

Labor: Detail the total number of persons and their level of commitment for each position listed (in sections A and B), as well as which specific tasks (as described in the SOW) they will support. (2) Equipment (section C) Provide an explanation for listed requested equipment exceeding \$5,000, properly justifying their need to meet the objectives of the program. (3) Travel (section D) Provide the purpose of the trip, number of trips, number of days per trip, departure and arrival destinations, number of people, etc. (4) Other Direct Costs (section F). Provide a justification for the items requested and an explanation of how the estimates were obtained.

Proposing PIs are limited to one full proposal submission to only one TA under this RA. Submitting more than one full proposal may result in all of the PI's proposal submissions being determined non-conforming and being removed from award consideration.

Potential applicants are encouraged to carefully consider the descriptions of the TAs before submission. A full proposal must specify ONE and only one of these TAs for the submission and identify this TA on the submission cover sheet. Full proposals that do not clearly address a specific topic may be deemed non-conforming and may not be reviewed. DARPA reserves the right to assign proposals to a different TA than indicated by the proposer.

Full proposals must not be submitted to DARPA via email. See Section IV.E.1.b for proposal submission instructions.

a. Full Proposal Format

All proposers are required to use the templates provided as Attachments B, C, D, and E to this solicitation on www.fbo.gov and <http://www.grants.gov>.

3. 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. Government National Security Information as dictated in Executive Order 13526 and should not be used to identify proprietary business information. See Section V.B.1 for additional information.

4. Security Information

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

Security classification guidance and direction via a Security Classification Guard (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

Proposers are warned that submission deadlines as outlined herein are in Eastern Time and will be strictly enforced. When planning a 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 Data Universal Numbering System (DUNS) number or Taxpayer Identification Number (TIN)).

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 RA Administrator at YFA2019@darpa.mil to verify receipt.

1. Executive Summaries

Executive summaries must be submitted per the instructions outlined herein *and received by DARPA* no later than the due date and time listed in Part One: Overview Information. Executive summaries received after this time and date may not be reviewed.

2. Full Proposals

Full proposal packages--full proposal (Technical and Management Volume, Cost Breakdown, Administrative and National Policy Requirements, Summary Slide) and, as applicable, proprietary subawardee cost proposals, classified appendices to unclassified proposals-- must be submitted per the instructions outlined herein *and received by DARPA* no later than the due date and time listed in Part One: Overview Information. 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. Failure to comply with the submission procedures outlined herein may result in the submission being deemed non-conforming and withdrawn from consideration.

a. Executive Summaries

DARPA will employ an electronic upload submission system (<https://baa.darpa.mil/>) for all UNCLASSIFIED executive summaries sent in response to this solicitation. *Executive Summaries must not be submitted via Grants.gov, via hard copy, or via email.*

First time users of the DARPA 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 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 executive summary.

Proposers who already have an account on the DARPA 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 executive summary submission. Note: proposers who have created a DARPA 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 executive summaries submitted electronically through the DARPA 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 executive summary and executive summaries not uploaded as zip files will be rejected by DARPA.

Technical support for the DARPA 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 YFA2019@darpa.mil. Questions regarding submission contents, format, deadlines, etc. should be emailed to YFA2019@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, DARPA discourages waiting until the day executive summaries are due to request an account and/or upload the submission. Note: Proposers submitting an executive summary via the DARPA Submission website MUST (1) click the “Finalize” button in order for the submission to upload AND (2) do so with sufficient time for the upload to complete prior to the deadline. Failure to do so will result in a late submission.

b. Proposals Requesting a Grant

Proposers requesting grants may only submit proposals through ONE of the following methods: (1) electronic upload at Grants.gov (DARPA-preferred); or (2) direct mail/hand-carry to DARPA.

i. Electronic Upload

DARPA encourages grant 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 up to four weeks so registration should be done in sufficient time to ensure it does not impact a proposer's ability to meet required submission deadlines.* Registration requirements and instructions are outlined at <http://www.grants.gov/web/grants/register.html>.

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. *Note: 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. DARPA will send a final confirmation email as described in Section IV.C.

To avoid missing deadlines, Grants.gov recommends that proposers submit their proposals to Grants.gov 24-48 hours in advance of the proposal due date to provide sufficient time to complete the registration and submission process, receive email notifications and correct errors, as applicable.

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

ii. Direct Mail/Hand-carry

Proposers electing to submit grant proposals via direct mail or hand-carried must provide one paper copy and one electronic copy on CD or DVD of the full proposal package. Proposers must complete the SF 424 R&R form (Application for Federal Assistance, Research and Related) provided at Grants.gov as part of the opportunity application package for this RA and include it in the proposal submission. All parts of the proposal package must be mailed or hand-carried to the address noted in Section VII below.

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 innovative, feasible, achievable, and complete.

The proposed technical team has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome that achieves the goal can be expected as a result of award. The proposal identifies major technical risks and planned mitigation efforts are clearly defined and feasible. The proposed schedule aggressively pursues performance metrics in an efficient time frame that accurately accounts for the anticipated workload.

- **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 make pivotal early technology investments that create or prevent strategic surprise for U.S. National Security.

The proposed intellectual property restrictions (if any) will not significantly impact DARPA'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 and the basis for the estimates).

B. Review and Selection Process

DARPA will conduct a scientific/technical review of each conforming proposal. Conforming proposals comply with all requirements detailed in this RA; proposals that fail to do so may be deemed non-conforming and may be removed from consideration. Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons.

The 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. Proposals that are determined selectable will not necessarily receive awards (see Section II). Selections may be made at any time during

the period of solicitation. For evaluation purposes, a proposal is defined to be the document and supporting materials as described in Section IV.

1. Handling of Source Selection Information

DARPA policy is to treat all submissions as source selection information (FAR 2.101 and 3.104), and to only disclose their contents to authorized personnel. Restrictive notices notwithstanding, 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. Subject to the restrictions set forth in FAR 37.203(d), DARPA may also request input on technical aspects of the proposals from other non-Government consultants/experts who are strictly bound by the appropriate non-disclosure requirements.

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 via email to the RA mailbox, provided the formal request is received within 5 business days after being notified of submission status.

C. Federal Awardee Performance and Integrity Information (FAPIIS)

Following the review and selection process described above, but prior to making an award above the simplified acquisition threshold (FAR 2.101), DARPA is required³ to review and consider any information available through the designated integrity and performance system (currently FAPIIS). Selectees have the opportunity to comment on any information about themselves entered in the database. DARPA will consider any comments and other information in FAPIIS or other systems prior to making an award.

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

1. Solicitation Provisions and Award Clauses, Terms and Conditions

Solicitation provisions relevant to DARPA RAs are listed on the Additional BAA Content page on DARPA's website at www.darpa.mil/work-with-us/additional-baa. This page also lists award

³ Per 41 U.S.C. 2313, as implemented by FAR 9.103 and 2 CFR § 200.205.

clauses that, depending on their applicability, may be included in the terms and conditions of awards resultant from DARPA solicitations. This list is not exhaustive and the clauses, terms and conditions included in a resultant award will depend on the nature of the research effort, the specific award instrument, the type of awardee, and any applicable security or publication restrictions.

For terms and conditions specific to grants, see the DoD General Research Terms and Conditions (latest version) at www.onr.navy.mil/Contracts-Grants/submit-proposal/grants-proposal/grants-terms-conditions.aspx and the supplemental DARPA-specific terms and conditions at www.darpa.mil/work-with-us/contract-management#GrantsCooperativeAgreements.

The above information serves to put potential proposers and awardees on notice of proposal requirements and award terms and conditions to which they may have to adhere.

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

All proposers must be registered in SAM unless exempt per FAR 4.1102. FAR 52.204-7, “System for Award Management” and FAR 52.204-13, “System for Award Management Maintenance” are incorporated into this BAA. See www.darpa.mil/work-with-us/additional-baa for further information.

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

- DUNS number
- TIN
- Commercial and Government Entity (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).

3. Representations and Certifications

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

4. 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, awardees 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

awardees, though DARPA will have, at a minimum, Government Purpose Rights (GPR) to technical data and computer software developed through mixed 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. Other Types of Awards

Proposers requesting a grant 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. 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 non-conforming. A template for complying with this request is provided in Section IV.B.2.

5. Human Subjects Research (HSR)/Animal Use

Proposers that anticipate involving human subjects or animals in the proposed research must comply with the approval procedures detailed at www.darpa.mil/work-with-us/additional-baa, to include providing the information specified therein as required for proposal submission.

6. Controlled Unclassified Information on Non-DoD Information Systems

All proposers and awardees will be subject to the DARPA requirements related to Controlled Unclassified Information on Non-DoD Information Systems as detailed at www.darpa.mil/work-with-us/additional-baa.

7. Electronic Invoicing and Payments

Awardees will be required to submit invoices for payment electronically via Wide Area Work Flow (WAWF) at <https://wawf.eb.mil>, unless an exception applies. Registration in WAWF is required prior to any award under this RA.

8. Electronic and Information Technology

All electronic and information technology acquired or created through this RA must satisfy the accessibility requirements of Section 508 of the Rehabilitation Act (29 U.S.C. § 749d) and FAR 39.2.

9. Publication of Grant Awards

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

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. Patent Reports and Notifications

All resultant awards will contain a mandatory requirement for patent reports and notifications to be submitted electronically through i-Edison (<https://public.era.nih.gov/iedison>).

VII. Agency Contacts

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

- **BAA Email:** YFA2019@darpa.mil
- **BAA Mailing Address:**
DARPA/DSO
ATTN: DARPA-RA-18-02
675 North Randolph Street
Arlington, VA 22203-2114
- **DARPA/DSO Opportunities Website:** <http://www.darpa.mil/work-with-us/opportunities>

For information concerning agency level protests see <http://www.darpa.mil/work-with-us/additional-baa#NPRPAC>.

VIII. Other Information

A. Frequently Asked Questions (FAQs)

Administrative, technical, and contractual questions should be emailed to YFA2019@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 10 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 RA expiration date as stated in Part I.

B. Collaborative Efforts/Teaming

This RA solicits single Principal Investigator (PI) proposals; no co-PIs are allowed. However, investigators will be given the opportunity to propose teaming if the nature of the proposal requires it. Combined, teaming and subcontract awards will be limited to no more than 30% of the total grant value. Specific content, communications, networking, and team formation will be the sole responsibility of the participants.

C. Proposers Day

The Proposers Day will be held on August 8, 2018 from 1:30 PM to 3:30 PM. The event will be held via a webcast only. Advance registration is required. See DARPA-SN-18-64 posted at www.fbo.gov for all details. Participation at the webcast for YFA Proposers Day is voluntary and is not required to propose to this solicitation.