Research Announcement

Young Faculty Award (YFA)

Defense Sciences Office

DARPA-RA-17-01

September 7, 2017

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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-17-01

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

- **Dates** (All times listed herein are Eastern Time.)
  - Posting Date: September 7, 2017
  - Executive Summary Due Date: October 2, 2017, 4:00 p.m.
  - FAQ Submission Deadline: November 27, 2017, 4:00 p.m. See Section VIII.A.
  - Full Proposal Due Date: December 4, 2017, 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:** YFA2018@darpa.mil

  - **RA Mailing Address:**
    DARPA
    ATTN: DSO/DARPA-RA-17-01
    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 Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 as well as 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 2018 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. 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 YFA2018@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. Designing Ungameably Complex Games

The effects of different incentive structures on shaping human behavior are well documented, and in simple contexts, are increasingly understood and predictable. However, in complex environments, the number of different potential variables at play and the dynamic nature of their interactions often means that otherwise rationally designed incentive structures – seeking to produce optimal social results – can lead to emergent, unintended and often unanticipated behavioral outcomes. These emergent behaviors in complex environments present real challenges for finite human capabilities to anticipate the impact of different incentive structures on a wide range of policy-relevant domains. From public health behaviors to improving the transparency and reproducibility of research, to effective deterrence in asymmetric and Gray Zone scenarios, these complex environments continue to illustrate the adage that "if you name it, humans will game it," often leading to less-than-optimal outcomes. However, advances in computing power and simulation platforms, as well as in evolutionary game theory, behavioral economics, organizational psychology, anthropology, and computational social science, suggest that there may be new opportunities to use simulations to help humans better design and anticipate unintended outcomes of different incentive structures for complex environments. This topic seeks to develop and explore simulations (which may include, but need not be limited to agent-based modeling, system level models, entomological models, etc.), in order to enable humans to more predictably achieve socially optimal outcomes, or at least anticipate unintended outcomes, even in the face of complexity. Proposers should identify their domain(s) and problem(s) of interest (public health, deterrence, etc.), their relevance to DoD, and clearly articulate why designing incentive structures for those domains and problems are complex. Proposers should detail how their simulation approach will advance beyond the state of the art to design "Ungameable games" for this complexity. Proposers should discuss mechanisms for incorporating new insights or theories from relevant disciplines and should propose approaches for validating their simulations, as well as ranking simulation outputs of potential unanticipated consequences in terms of probability, departure from intended outcomes, and credibility. Please note that submissions without a strong validation plan will not be considered.

2. Topological Photonics

Topological states in electronic materials are intrinsically protected against localized imperfections and perturbations. For example, skyrmions in magnetic heterostructures have been proposed as a suitable platform for compact and low power memory applications. However, this "topological protection" is not limited to electrons– it is a universal

phenomenon that applies to any wave-based system. That realization has recently spurred a major research effort towards utilizing the incredible robustness of topological materials in other domains of wave physics. Novel topological properties arising from topological edge states in 2D have been demonstrated in a plethora of wave platforms recently, but the realization of 3D topological phenomena has been limited. This topic seeks innovative approaches to implementing topological states in photonic materials and demonstrating their capabilities. Work will focus on designing and fabricating such structures as well as validating their topological properties. A fundamental component of the work will be in demonstrating the benefits derived from the topological protection as compared to the state of the art (using conventional techniques).

3. Artificial Intelligence for Materials Discovery

Identifying and synthesizing materials with desired properties typically involves complex physics-based computational modeling, trial-and-error synthesis/test cycles, or both. These methods are time and resource-intensive and only sparsely sample the available parameter space for a given class of materials. DARPA is interested in new approaches that accelerate material design to ultimately enable rapid discovery of material compositions and architectures from existing knowledge (e.g., expertise, publications, patents, lab notebooks, etc.) Two-dimensional polymers are materials of recent technological interest that would benefit from such an approach, given the vast design space for composition (i.e., molecular components) and architecture (e.g., patterned, porous, graded and layered structures), which both affect resultant properties. Proposers to this YFA topic should develop approaches that (1) accelerate discovery of new two-dimensional polymers, considering both composition and architecture, and (2) reduce uncertainty between the initial design and the final tested properties. Approaches should not rely on physical models, but rather exploit prior knowledge and data with artificial intelligence tools. Projects must include a validation step, in which materials are synthesized and tested for the designed property set. While DARPA will not specify properties of interest, approaches with the broadest capability, such as those that provide complex multifunctional and dynamic properties are highly encouraged. Proposals should specifically address how the proposed approach may be broadly applied to a more diverse set of material classes, if successful.

4. Transformative Radiation Sensing

Room-temperature, high-resolution materials continue to be a limitation for radiation sensing required for weapons of mass terrorism (WMT), nuclear/radiological threat interdiction, counter-proliferation, and post-event consequence management. High-resolution materials are considered paramount in differentiating threat materials from benign environments or nuisance sources of radiation, and in supporting effective secondary and tertiary consequence management operations. Traditional scintillator materials suffer from low resolution (due to signal loss from initial radiation interaction) and loss of fidelity in scintillation and light collection performance, while crystalline semiconductor materials suffer from poor electrical properties impacting charge collection. These factors have limited advances in radiation sensing for more than 30 years. This topic seeks unconventional approaches to gamma-ray sensing using next-generation nanofabrication techniques or other novel approaches that can

achieve high resolution (sub 1% energy resolution at 662 keV) in large volumes (greater than 8 cm3 volume) with high mass-density materials. Neutron detection is desired, but not a requirement for this material, and should be achieved with very high neutron/gamma discrimination and no compromise in gamma detection performance. Conventional crystalline scintillator or semiconductor materials or hybrid organic-inorganic matrices are excluded from this topic.

5. Engineered Interactions with the Energy of the Vacuum

The Lamb shift and Casimir effects are manifestations of vacuum fluctuation phenomena, as is the role of those fluctuations in quantum friction. Quantum field theory predicts a high-energy density for the vacuum, which can have gravitational effects. The Mach principle suggests high gravitational potentials surround us due to matter distributed throughout the cosmos. Unruh radiation may suggest a "thermal" Mach principle and could explain a number of phenomena such as photon detector dark counts and the variability of inertial mass with acceleration. Is there a so-called vacuum energy "catastrophe" that needs to be revisited (e.g., Am. J. Phys 63 (7) 620 (1995))? The goal of this research is to advance our understanding of the interaction between electromagnetic waves and matter, in the presence of this apparent all-pervasive energy content of the vacuum. How does the vacuum energy density vary in the presence of matter, are there local energy minima, and does the vacuum define very general and fundamental properties of both matter and electromagnetic waves? We seek testable hypotheses that advance our understanding of the possibility of harnessing and/or harvesting the energy of the vacuum combined with tangible experimental plans (e.g., propulsion, entanglement, etc.) that could verify and validate those hypotheses.

6. Novel Methods for Nonsurgical Brain Interfaces

The future of brain-computer interaction for able-bodied people relies on the development of neural interface technologies that are minimally invasive and have high spatiotemporal resolution. DARPA seeks innovative approaches to brain interface methods that do not require neurosurgical implantation. Technologies located at or above the body surface, or which can be easily injected via a hypodermic needle are within scope. This topic welcomes approaches that enable modulation of neural activity and/or measurement of neural activity – technologies are not required to be bi-directional. Emphasis should be placed on achieving high temporal and/or spatial resolution. While no strict requirements are sought for resolution, proposed specifications should be a significant improvement upon existing technologies. Incremental advances on existing approaches, such as EEG, fMRI, and fNIRS, are not within scope. Proposed methods should be realistic for near-term (<5 years) translation to use in healthy humans and should not incorporate aspects such as genetic engineering. Both signal-to-noise ratio and real-time requirements should be identified in the proposal and validated within the period of performance. Human use is not required within the period of performance, but final demonstrations should, at a minimum, include validation in live animal models with assessments of temporal and spatial resolution and potential applicability to humans.

7. Self-forming Chronic Central Nervous System (CNS) Neural Interfaces

Traditional neural interfaces have a bulk size that is many orders of magnitude larger than individual neurons or small neural networks. As a result, large burr holes or craniotomies are necessary to neurosurgically implant the devices into the brain. To overcome this implantation obstacle, DARPA seeks innovative technologies in the area of self-forming neural interfaces in the CNS. Interfaces that are primarily composed of, or readily incorporate biologically-based materials are within the scope of this topic. For example, concepts are sought that explore "electrode" growth towards select neuron(s) of interest, or select neuron(s) of interest growing towards the "electrode." Rather than general targeting in a localized cortical area, selective connections with specific neurons of interest are required. Proposers must deliver electrode constructs at a location distal to the target brain site of interest and the sensor should self-form to create the final transducer device. Of potential interest would be to leverage the developing nervous system such that the interface integrates with the growing animal from early life stages. The end goal is to develop persistent, high-yield, bi-directional neural interfaces that are operational over the lifetime of the animal. Incremental or iterative improvement on existing technologies are not within scope of this topic. Both invertebrate and vertebrate models would be considered, however mammalian models would be given higher priority.

8. The Minimal Plant: Engineering Plants for Easy Biosynthetic Pathway Design with High Modularity

Plants as a platform for synthetic biology can provide an elegant and robust system that is scalable. Unlike microbial cells, which have limitations due to the accumulation of products that cause feedback inhibition, off-target effects such as toxicity, and exhaustive infrastructures necessary to maintain growth at scale, plants are autonomously maintained living organisms with greater potential bandwidth as chassis. However, all organisms have drawbacks as synthetic biology platforms due to the substantial increase in their complexity. Therefore, the development of a minimal plant, where the genome only encodes the minimal set of genes necessary for the plant to survive, would provide a powerful and flexible chassis. We seek proposals aimed at using plants to meet unique DoD challenges. Acceptable approaches should identify and remove nonessential genes, where inactivation does not affect the autonomy, viability, or growth rate of the plant, for a defined environment and DoD-relevant use case. Approaches will not be considered that only include the introduction of multiple genes into plants, or use iterative processes, such as successive rounds of crosses between transgenic lines.

9. Antifouling Solutions for Large, Nonplanar Optical Surfaces

Biofouling remains a significant challenge for optical interfaces on marine sensors and platforms, as well as implantable medical devices. While progress has been made towards the development of transparent antifouling materials and coatings, scrapers and shutters remain the gold standard for use with marine optical sensors. Such mechanical defenses work well on small, flat windows, but they are incompatible for use with large or non-planar surfaces. Alternative approaches using UV radiation, consume an unacceptably large amount

of a sensor's power budget when needed to treat large areas. This topic seeks ideas for non-toxic, biomimetic or biological antifouling coatings, textures or materials that can be used with large (30 x 15 x 15 cm3 dimensions), non-planar optical surfaces. Antifouling materials that minimize optical attenuation and remain flexible from 15 – 40° C are of particular interest.

10. Replicating Cell-Cell Information Transfer

Currently, our ability to transfer information from an electronic system to a biological one is limited, often relying on methods with low resolution or that perturb the cell far from its equilibrium state. This topic seeks proposals for a device that converts electronic information, such as a voltage pulse, into native biochemical information, such as a neurotransmitter or a growth factor, in a way that replicates cell-cell communication. Specifically, the device must release the biochemical agent with a temporal resolution comparable to the native signaling system and with sufficient spatial resolution (≈ 20 μm) to enable communication with a single cell. Critically, the biochemical agent must be released in a diffusive manner, since advection would wash away existing signaling agents. Only methods that can eventually be scaled to produce an array of tightly packed devices are of interest. Success will pave the way for communication with any cell and improve prosthetics, neural interfaces, and sensors.

11. Programmable DNA Repair for Improved Genome Editing Outcomes

DARPA is interested in the development of technologies that increase the probability and reliability of desired genome editing outcomes through the modulation and control of DNA repair pathways. Because the repair of gene editing-induced DNA lesions is mediated by error-prone endogenous cellular processes, outcomes can often be unpredictable, imprecise, or undesirable (e.g., indels). Furthermore, DNA repair pathway choice can vary significantly depending on cell type/stage, host genetics, and editor choice. DARPA is specifically interested in the discovery and development of methods that reliably and predictably bias DNA repair processes, maximizing the introduction of exogenous DNA sequences into the genome in vivo, while minimizing both unwanted editing outcomes (e.g., indels, off-target editing, genome instability, translocations) and other deleterious outcomes in cells and tissues that might result from DNA repair pathway modulation. Proposers are encouraged to pursue the development of programmable DNA repair strategies for DARPA-relevant applications.

12. Efficient Integrated Nanophotonics

Integrated photonics has become an essential ingredient in many DoD applications, from computing and communications, to sensing, timing, and navigation. The optoelectronic emitters and modulators that enable photonic integrated circuits are relatively large in size (i.e., tens of microns to millimeters in length) due to the limits of optical confinement and weak light-matter interaction in traditional materials. Reducing component dimensions to the sub-micron scale would enable much higher integration density, bandwidth, and power efficiency, and may also enable new functionality for emerging applications. A variety of

promising nanophotonic concepts have been explored to date, but device demonstrations have typically shown severe performance limitations that will preclude their use in practical systems.

This topic seeks new innovations in the field of integrated nanophotonics with an emphasis on high-efficiency active components. The objective is to minimize device footprint while maintaining losses comparable to those of traditional optoelectronics. Of particular interest are sub-micron-sized optical phase and/or amplitude modulators capable of modulation bandwidths from 1 GHz to 100 GHz, depending on the application, and nanoscale lasers and/or LEDs with high external quantum efficiency. Proposers will be expected to combine fundamental theoretical and numerical studies with experimental efforts to enable performance validation and proof-of-concept demonstrations. The goal of this effort is to accelerate the incorporation of nanophotonics into integrated photonic platforms of interest to the DoD, and applicants should outline paths to practical realization and real-world deployment.

13. Adversarial Artificial Intelligence (AI)

The next wars may be decided by artificial intelligence (AI). Our adversaries are developing AI technology that creates revolutionary offensive and defensive capabilities. We must ensure that our technology is superior. This topic seeks the development of innovative links between machine learning and cryptography/security; these links are just starting to form in the theoretical academic community. The combination of cryptography with lifelong learning will be the centerpiece in defending against powerful adversarial tactics, resisting spoofing, and in designing invincible responses. At the same time, it will protect against communication channel attacks and software reverse engineering, and protect against exploitation of hardware in case it is captured. The algorithms will, to the extent possible, offer human-understandable explanations of their recommendations. The goal is to pursue both short-range – in space and time – and long-range functions, enabling new advancements in electronic warfare, air, sea, land, space, and cyber combat tactics.

14. Developing Intelligent Sensors for Fentanyl and Related Toxins

Synthetic opioid analogues have been the cause of many accidental deaths across the world. The subject of this topic is the detection of fentanyl (50-100 times as potent as heroin) and Carfentanil (10,000 times as potent as heroin and 100 times as potent as fentanyl). Even a small amount of these substances when dispersed in the air can be lethal. For example, α-Methylfentanyl will kill 50% of exposed individuals (LD50) with a dose as small as 8.6 mg/kg. Military and first responders also face similar challenges with toxic compounds entering areas with unknown chemicals and unknown risk. The detection of low concentrations of these harmful substances at a distance is crucial for the DoD as well as law enforcement. The proposed topic is the development of a handheld device that is ruggedized, computationally robust, power efficient, and has the capability for remote detection. The device will be capable of sensing fentanyl and its analogues in the air and on surfaces even when mixed with other chemical agents for concentrations as low as 0.1%. Additionally, it will be capable via machine learning techniques of recognizing new fentanyl related compounds.

15. High Quality Atomic Traps and Waveguides

Atom trapping, guiding, and coherent manipulation of matter waves are essential for the demonstration of matter wave devices and "atomtronic" concepts in a small size in the presence of gravity. Many concepts for inertial sensing, information storage and other matter-wave manipulations would use atom traps with continuous periodic architectures either spatial (e.g,. circles) or temporal (e.g., harmonic oscillators). Atom traps should maximize two quantities simultaneously: the time and the distance that two or more phase coherent matter waves can maintain a predictable and measurable phase difference over the entire spatial extent of the matter wave or ensemble of waves. Novel matter waveguide concepts are sought that would greatly enhance atom trap quality. Topic responses will clarify how their concept advances the state of the art while avoiding technical issues like trap non-uniformity, unwanted atom interactions, phase diffusion, atom-surface interactions, gravitational alignment, and how atoms waves will couple in and out of the trap. Proposed architectures should be consistent with a portable system (e.g., small size and low power requirements) and preferably integrate with other planar technologies (e.g., atom chips or photonic integrated circuits).

16. Wideband Efficiency in Millimeter Wave Power Amplifiers

As millimeter wave frequency applications have become more prevalent in the commercial and DoD markets, there is a growing need for advanced power amplifier technology. This is especially true for communication applications where high peak-to-average power ratio waveforms are used. When evaluating the state-of-the-art, there has been significant work in narrowband (10-30%), designs that maximize saturated power or focus on improved efficiency at power back off in addition to wideband designs that are only efficient when driven deep into saturation. This YFA topic seeks innovative power amplifier designs that combine aspects of each of these approaches to achieve efficiency in power back off over a wide bandwidth. While SiGe and CMOS technology has greatly advanced over time and led

to innovation in circuit architectures, this YFA topic seeks to apply some of these architectural insights developed in silicon-based RFICs to designs implemented in compound semiconductors such as GaN and InP to achieve unprecedented combinations of power, bandwidth and efficiency not achievable with silicon technology. Specifically, this YFA topic seeks to push the state-of-the-art toward more than 23 dBm saturated power over the entire 30-100 GHz frequency band with a peak efficiency of >50% and a reduction of no more than 10 percentage points in efficiency at 6 dB power back-off.

17. Materials and Actuator Innovation for Small Scale Mobility and Manipulation

In the area of miniaturized robotics, high force, low power actuation mechanisms are critical for enabling self-contained mm-to cm-scale robotic systems, actuation surfaces for increased maneuverability and morphing, and artificial muscle-like performance for prosthetics. The topic seeks to push the realm of realizable high force actuator materials and actuators with voltage and power consumption commensurate with conventional electronics and lightweight and small form factor power supplies. Specifically, the topic seeks innovation in materials engineering and integration approaches to enable self-contained solutions where the resulting materials could produce actuators and mechanisms with force-displacement characteristics in excess of 10E-08 (N-m) while having the ability to also integrate their own power supply and necessary power electronics without adversely affecting actuator performance.

18. Reducing Software Attack Surface through Compiler-Rewriter Cooperation

Complex software comprises a conglomeration of generic programming libraries and modules, targets multiple users and scenarios with different needs, and supports a variety of processor generations with additional capabilities. Indicatively, in the span of just five years, more than 20 new security-related extensions have been introduced into the x86 architecture. This results in a significantly increased attack surface due to the large amount of unneeded but present code and functionality and missed opportunities for adopting more comprehensive protections that require code restructuring, due to the need for backwards compatibility. At the same time, the resulting software monoculture is an important facilitator for the wide-scale exploitation of software vulnerabilities, as the same code image is used on every system. Moving beyond the "compile once, run everywhere" model can enable self-adapting software that specializes its code and logic and diversifies its memory footprint to reduce its attack surface and shield itself against vulnerability exploitation. This effort will explore compiler-rewriter cooperation approaches that will enable self-adapting software according to the characteristics and capabilities of each endpoint.

19. Computational Models of the Spread of False or Misleading Information

This topic seeks development of computational models to characterize false or misleading information that is disseminated by various entities, either intentionally or unintentionally, including falsified news reports, disinformation campaigns, rumors, hoaxes, etc. DARPA believes it would be valuable to explore the dynamics of the spread of false information, as well as its evolution over time and effects on the global information space. The goal is to expand understanding of the flow of false information through current and emerging

information sharing and dissemination platforms, including news media, social media, and other massive multi-participant open communication media, with the hope of improving verification of genuine information and exposure of false information.

20. Big Data Summarization

This topic seeks development of technologies to summarize large non-textual datasets. In cases when human users cannot analyze large data repositories, users would nonetheless appreciate summarization technologies that identify representative examples of dataset content. Representative examples should provide an intuition for what types of information reside within a large dataset. A fundamental component of this work will be identifying the features, objective functions, and optimization techniques used for summarization. Techniques that scale to millions, billions, or trillions of data items are of interest. In addition, evaluation strategies should provide evidence that summarization techniques will identify data subsets that a human user might extract to summarize data for another human.

21. Decentralized Control of Networked Unmanned Autonomous Systems

Our adversaries have invested heavily in anti-access area denial (A2AD) technologies that threaten our current military advantages. Meanwhile, the cost for us to field (as well as the time to field) the next generation of exquisite military capabilities has grown exponentially. To counter these challenges, the services and defense research agencies are exploring complex "system of system" architectures employing low-cost unmanned autonomous systems (UAS) teamed with manned platforms. The long-term vision is a large number of heterogeneous UAS collaborating (over communication links that are unreliable and low bandwidth) to accomplish complex missions with little oversight by human operators. This topic seeks to develop decentralized optimal control techniques that will contribute to the vision of large networks of diverse UAS executing complex missions relying on intermittent, low bandwidth communications and on-board sensing. Of particular interest are techniques (based on current research in areas such as mechanism design and team theories) enabling the dynamic formation of UAS teams and coalitions appropriate to achieve sub-goals within the overall mission.

22. REsilience through COmposable Logistics (RECOiL)

Humanitarian disasters, such as Hurricane Katrina, the Ebola outbreak, and the Syrian refugee crisis, affect nearly 200 million people every year. The sharply growing demand for humanitarian actions [1], combined with humanitarians' limited resources, necessitates coordination and resource pooling among humanitarian actors to improve relief chain resilience. Despite recent initiatives [2], coordination among Humanitarian Organizations (HOs) has not been a priority on HOs' agenda. This topic will develop models that evaluate the incentives that drive organizations to cooperate in an extremely resource constrained and time challenged environment, and seeks technologies that assess the effectiveness and robustness of potential relief chains. Emphasis should be placed on exploring the relationships between the various actors when determining the formation of relief chains. HOs fail to coordinate for many reasons including number and diversity of actors, differences

in organizational structure, strategic plans, and donors' interests. A lack of mutual trust and respect, unfavorable operational conditions, high level of demand/supply uncertainty, funding structure and financial vulnerability along with media exposure, and cost of coordination further contribute to the lack of coordination in this context. Proposers to this topic should address how various sources of uncertainty, including demand, supply, budget, and media exposure, exclusively and simultaneously influence HOs' coordination decision. Proposers should also consider risks and operational costs to formulate game models for designing coordination mechanisms between multiple HOs.

1. *Over the last 30 years, the number of natural disasters has escalated about six-fold and is expected to be five times larger than today, over the next 50 years.*

2. *Over the past few years large donors and international organizations have encouraged humanitarians to coordinate. For example, during 2006-2008 alone, the United Nations invested over $57 million into HOs' coordination in different sectors of activities.*

23. Wide Area Sensing Using the Internet of Things

Civil communication systems and Internet of Things (IoT) technologies can be used to augment or supplement U.S. military communications and sensing during operations. This concept will focus on benefits for our forces at the soldier level. What system of commercial sensors and communications devices are required to help us cost-effectively ensure the safety of our warfighters and their equipment? The effort will focus on inexpensive sensors deployed in very large numbers over a large city. Significant challenges requiring fundamental research include, but are not limited to:

- Direction finding and geolocation
- Multiple Access (MA) communications
- New wireless waveforms
- IoT device power management techniques
- Reliable pattern recognition

24. Tactical Terrain Analysis

DARPA is currently developing new minimalistic algorithms for high-speed navigation in cluttered, GPS-denied environments by small-unmanned air vehicles (sUAV). This topic seeks to enable autonomous tactical behaviors of sUAV in complex natural or man-made environments. New frameworks are needed to reason about how to move through a tactical environment to avoid detection. This effort will create and implement a new taxonomy of flight behaviors that apply to small UAS missions, such as minimizing duration of exposure, hiding, or perching, using only onboard sensors. Techniques may assume limited a priori models of a target site (e.g., street geometry but not vehicle placement) and will need to perform precise localization in three dimensions with respect to elements of the scene.

25. Thermostructural Sensitivity to Uncertainties

Hypersonic system structural integrity and the inherent risk involved are a perennial problem area in hypersonics. The penalties involved with system performance and cost challenge the very viability of the U.S. to obtain hypersonic capabilities. Improved modeling capability that seeks to improve our ability to understand and assess the risk inherent in the thermostructural response, such as sensitivity to variations/uncertainty in thermophysical and mechanical properties, is needed. For example, a reported failure margin provides no insight into the material and modeling uncertainties. Stochastic approaches to thermostructural response are one approach that may be needed to better understand structural integrity for systems using refractory composites such as carbon/carbon or ceramic matrix composites. This topic will need to seek to increase the fidelity of modeling multiple system uncertainties (material properties, boundary conditions, geometry, manufacturing, etc.) on the stress states to better understand the fidelity and risk with associated failure margins.

26. Swarm Intent Understanding

Rapid advances and the confluence of myriad technologies (to include machine learning, distributed computation, and rapid prototyping) offer future autonomous swarms with increasingly sophisticated capabilities with complex composite behaviors, potentially well beyond human interpretation. Efficient and effective interactions with such complex swarm systems will require new methods for swarm understanding. This topic explores the computational foundations and realizable technologies by which to observe and extract salient swarm features, to categorize and comprehend underlying swarm (and sub-swarm) behaviors, and to predict likely future swarm actions and/or responses to active interrogations. Emphasis should be placed on a realizable framework addressing the realities of physical operating environments and constraints (e.g., observation uncertainty, computational and communication limitations, physical interactions between robots, heterogeneous robot dynamics and states). Innovative approaches that yield insights (and the means to assess their fidelity) into the tactical intent of the autonomous swarm are of interest.

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 proposers[1] whose proposals are determined to be the most advantageous to the Government, all evaluation factors considered. See Section V for further information.

[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.).

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.

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 Award 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 subs – 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 principal investigator. 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. (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 subs.

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 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. 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

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-conforming[2] and removed from consideration. All executive

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

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.

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 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 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. Potential applicants 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's 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 1 to this solicitation on www.fbo.gov and http://www.grants.gov.

2. Full Proposal Information

Complete Full Proposals consist of Volume 1: Technical and Management Volume (template provided as Attachment 2), Volume 2: Cost Volume (template provided as Attachment 3), and Volume 3: Administrative and National Policy Requirements (template provided as Attachment 4), and the proposal summary slide (template provided as Attachment 5).

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's 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 topic area 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 2, 3, 4, and 5 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 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 DUNS number or 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 YFA2018@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 Volume, 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 YFA2018@darpa.mil. Questions regarding submission contents, format, deadlines, etc. should be emailed to YFA2018@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.

- **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 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 required[3] 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 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.

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

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
- 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:** YFA2018@darpa.mil

- **BAA Mailing Address:**

  DARPA/DSO
  ATTN: DARPA-RA-17-01
  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 YFA2018@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 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.