



Broad Agency Announcement

Invisible Headlights (IH)

Defense Sciences Office

HR001120S0045

Amendment 2

May 15, 2020

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PART I: OVERVIEW INFORMATION

- **Federal Agency Name:** Defense Advanced Research Projects Agency (DARPA), Defense Sciences Office (DSO)
- **Funding Opportunity Title:** Invisible Headlights (IH)
- **Announcement Type:** Initial Announcement
- **Funding Opportunity Number:** HR001120S0045
- **Catalog of Federal Domestic Assistance (CFDA) Number(s):** 12.910 Research and Technology Development
- **Dates** (All times listed herein are Eastern Time.)
 - Posting Date: April 17, 2020
 - Proposers Day: March 16, 2020. See Section VIII.B.
 - Abstract Due Date: May 08, 2020, 4:00 p.m.
 - FAQ Submission Deadline: June 03, 2020, 4:00 p.m. See Section VIII.A.
 - Full Proposal Due Date: June 17, 2020, 4:00 p.m.
- **Anticipated Individual Awards:** DARPA anticipates one or more awards in Technical Area 1 and one or more awards in Technical Area 2.
- **Types of Instruments that May be Awarded:** Procurement contracts, cooperative agreements or other transactions
- **Agency contacts**
 - **Technical POC:** Joseph Altepeter, Program Manager, DARPA/DSO
 - **BAA Email:** InvisibleHeadlights@darpa.mil
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DARPA/DSO
ATTN: HR001120S0045
675 North Randolph Street
Arlington, VA 22203-2114
 - **DARPA/DSO Opportunities Website:** <http://www.darpa.mil/work-with-us/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 Broad Agency Announcement (BAA) constitutes as 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 C.F.R. § 200.203. Any resultant negotiations and/or awards will follow all laws and regulations applicable to the specific award instrument(s) available under this BAA, e.g., FAR 15.4 for procurement contracts.

A. Introduction

The Defense Sciences Office (DSO) at the Defense Advanced Research Projects Agency (DARPA) is soliciting innovative research proposals in the area of passive three-dimensional (3D) vision using ambient thermal emissions. 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.

B. Background

Autonomous and semi-autonomous systems require active illumination to navigate at night or underground. This creates a significant vulnerability, as this active signature may be detected by adversaries kilometers beyond the useful sensor range. The Invisible Headlights program will develop solutions to eliminate this vulnerability by discovering how to exploit the ambient thermal light present in all environments using a totally passive 3D sensor that is accurate enough and fast enough to support autonomous navigation.

The Invisible Headlights approach is fundamentally different than previous efforts aimed at target recognition using infrared emissions. Conventional infrared sensors fail, by design, to collect almost all available information from ambient thermal emissions. Under the Invisible Headlights approach, non-target artifacts in the scene which might previously have been considered “clutter” will instead provide the signal needed to enable 3D vision. Because the utility of this approach is limited to the information content available in real scenes, the Invisible Headlights program will quantify the available information in ambient thermal emissions, determine how much of that information is useful for building a 3D model of a scene, define the tradespace of sensor designs capable of gathering this information, develop new sensors capable of dramatically increased measurement diversity, and validate all of the above via testing in the field.

In principle, ambient thermal emissions can be used to generate a 3D model of the environment using totally passive sensors. There are, for example, several approaches that might use thermal emissions to passively generate such 3D models. These include stereo ranging, optical flow, and atmospheric-absorption-based ranging. Each of these has advantages and drawbacks. For example, stereo ranging uses two or more cameras and triangulation to estimate the distance to a feature that is visible to both cameras. Optical flow exploits the same basic physics of triangulation using a single moving camera. Both methods have been demonstrated using monochrome thermal cameras, but these demonstrations often suffer from low image contrast;

triangulation cannot work unless both views of a scene contain a common image feature.

Even in scenes with very low contrast, atmospheric-absorption-based ranging can be used to estimate the range to an object by inferring the amount of atmosphere through which emitted thermal light must have traveled. This is analogous to inferring the distance to an object that is barely visible in a fogbank. For a given density of fog, a given amount of obscuration corresponds to a given distance. Given the huge range of absorptivity in the infrared spectrum, for any given distance there may be a particular wavelength that corresponds to just the right “density of fog.”

For each of these approaches, it remains an open question whether the ambient thermal emissions, particularly emissions present in the myriad off-road environments into which autonomous vehicles might one day be deployed, provide sufficient useful information. Real objects do not act as perfect black or gray bodies, nor do they exhibit the high visibility spectral contrast that might be measured in a spectroscopy lab; spatial, spectral, and polarimetric features are instead “washed out” by reflected and re-reflected thermal emissions from the entire scene.

Sensors capable of measuring more polarizations, wavelengths, and spatial modes per unit time – in other words, sensors capable of increased measurement diversity – could provide superior triangulation-based and atmospheric-absorption-based 3D vision. For triangulation, increased measurement diversity has the potential to increase contrast in a scene. Improved spectral resolution allows an imager to always find just the right “density of fog” to enable atmospheric-absorption-based 3D vision. Unfortunately, most conventional mid-wave infrared (MWIR = 3-5 μm) and long-wave infrared (LWIR = 7-15 μm) imagers utilize two-dimensional (2D) focal plane arrays that measure a single broad color band or 2D focal plane arrays where one axis maps to spatial modes and one axis maps to measured wavelength bands. Completely new types of sensors may be needed to enable dramatic increases in measurement diversity.

Note that triangulation-based and atmospheric-absorption-based 3D vision are used as examples only; proposers to the Invisible Headlights program are not limited to these approaches and are encouraged to propose better alternatives.

C. Program Description/Scope

The primary goals of the Invisible Headlights program are to

1. understand the useful information contained in ambient thermal emissions,
2. enable passive 3D vision for autonomous navigation.

Understanding ambient thermal emissions. Quantifying the measurable information from ambient thermal emissions is non-trivial and very environment-dependent. It depends on the temperature, chemical composition, geometry, and atmosphere surrounding the objects in a scene. Moreover, it depends on the aperture, position, measurement modes, and performance of the sensor or sensors. In practice, these environments are so complex that measurement, rather than modeling, is needed to characterize the actual signal variation as a function of spatial mode, polarization, and wavelength. However, the only hard limit physics places on this information content is shot noise. In principle, an ideal sensor might be able to extract many orders of

magnitude more data about the environment than is attainable using conventional infrared sensors. Invisible Headlights performers will quantify, characterize, and visualize the information content in a variety of outdoor environments. In addition, the Invisible Headlights program will determine how to exploit ambient thermal emissions for revolutionary technological advances.

Enabling passive 3D vision for autonomous navigation. The specific application of 3D vision for autonomous navigation can be used to derive clear performance metrics, such as spatial resolution, vision distance, and measurement time, which scale aggressively with vehicle speed (e.g., stopping distance scales quadratically as a function of speed). Therefore, the Invisible Headlights program will use passive 3D vision as a single common application to focus performers' research efforts. Because 3D vision from thermal sensors will have very different performance scaling and limits than light detection and ranging (LIDAR), it is possible that this approach could lead to a transformative new sensing technology for autonomous systems. Particularly for high-speeds, thermal sensors that enable 3D vision for autonomous navigation are expected to require near-zero noise and orders of magnitude greater measurement diversity than conventional sensors. This will likely require the development of completely new types of infrared sensors. Although the program metrics are focused on 3D vision for ground-based autonomy, sensors focused on other autonomy modes may be modeled and explored as part of the program.

The Invisible Headlights Program will be executed in three phases and development efforts will be divided into four primary areas:

- **Technical Area 1: Near-Term Passive 3D Vision**
 - In recent years, dramatic advances have been made in infrared focal plane technology; performer(s) in this Technical Area will modify and extend existing sensors in order to enable passive 3D vision sensors that have the potential for low-speed applications (speeds up to 25 mph).
- **Technical Area 2: Novel Sensors for Measurement Hyperdiversity**
 - Performer(s) in Technical Area 2 will develop near-zero-noise sensors capable of orders of magnitude more measurements per second than conventional sensors, enabling fast, high-spatial-resolution, high-spectral-resolution measurement of an environment, and high-speed 3D vision. Because this will be an entirely new class of infrared sensors, Technical Area 2 is expected to be a fundamental research activity. If successful, these new sensors will enable 3D vision for high-speed autonomy (speeds greater than 25 mph).
- **All Performers: Virtual Tradespace Exploration**
 - The single most important consequence of the Invisible Headlights program will be a quantitative understanding of the information contained in ambient thermal emissions, coupled with quantitative insight into what types of sensors can effectively exploit that information. Performers in TAs 1 and 2 will provide this understanding and insight by creating a quantitative tradespace of 3D vision performance as a function of widely varying sensor specifications.
- **Government Test and Evaluation (T&E) Team: Ground Truth Data Collection (not being solicited under this BAA)**

- In addition to providing Test & Evaluation of the sensor capabilities developed under TAs 1 and 2, the Government Team will create an unprecedented database of high spatial resolution and high spectral resolution measurements of ambient infrared emissions in a variety of outdoor environments, referenced to accurate 3D maps measured using LIDAR. This database will directly support the Virtual Tradespace Exploration efforts described above.

D. Program Structure

The Invisible Headlights program is a 57-month research and development effort comprising three phases, as illustrated in the figure below. Both Technical Areas will have the same periods of performance.

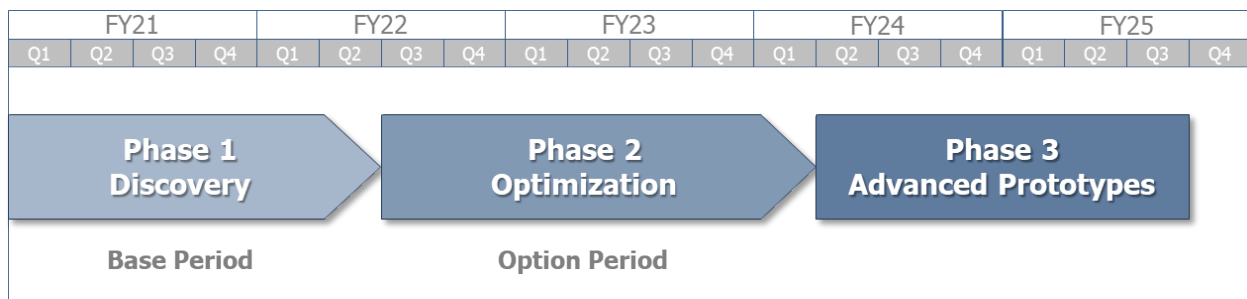


Figure 1 – High-Level Program Schedule

DARPA will use a phased acquisition approach for the Invisible Headlights program. Proposers should address all three phases and provide details for the Phase 1 (Base) and Phase 2 (Option) efforts as outlined in Section I.F below. Proposers should also provide a Rough Order of Magnitude (ROM) for Phase 3 including ROM costs, a draft statement of work (SOW), and any additional information on anticipated program plans. Proposals that do not address these Phase 3 goals may be deemed nonconforming.

Phase 1 (Discovery) is an 18-month effort to determine if thermal emissions contain sufficient information – in principle – to enable autonomous driving at night or underground. Phase 2 (Optimization) is a 21-month effort that builds on work in Phase 1 by refining models, creating experimental designs, and testing implementations to show that real systems can measure the information needed to enable 3D vision. If the Government elects to continue the program into Phase 2, it may exercise the option on the contract(s) of the selected performer(s) based on Phase 1 performance and the candidate technologies’ potential to meet the Phase 2 program goals and metrics. The Government retains the right to award all, some, one, none, or portions of the proposed Phase 2 options to support promising further technology developments.

Phase 3 of the program (Advanced Prototypes) will be an 18-month effort to build and test passive demonstration systems that can compete with active sensors. Prior to the completion of Phase 2, DARPA intends to issue Phase 3 proposal instructions requesting updated technical and cost proposals for Phase 3. Participation in the competition for Phase 3 is optional and will be limited to Phase 2 performer(s).

Evaluation of Phase 3 proposals will be based on criteria to be specified in the Phase 3 proposal instructions. The Phase 3 evaluation criteria will be consistent with the evaluation criteria in this solicitation, but may be tailored based on the program plan for Phase 3. Phase 3 proposal evaluations will be conducted through a scientific and technical review process in accordance with Section V.B. The Government reserves the right to issue a new solicitation for Phase 3 with a new award instrument if programmatic circumstances dictate.

Participation in Phase 2 does not guarantee funding in Phase 3; progression to the next phase will be contingent on evaluation of Phase 3 proposals and availability of funds.

E. Government-furnished Property/Equipment/Information

To support research and development, DARPA will supply performer(s) with a ground truth database of ambient infrared signals. The Government T&E Team will simultaneously collect high spatial/spectral resolution infrared imagery and accurate 3D maps using LIDAR. For example, a data collection might consist of stereo MWIR hyperspectral images collected at 1 meter intervals on a dirt road in rolling terrain. Ground truth data will be collected at multiple points throughout the program in multiple representative environments, such as desert, arctic, underground, temperate, and tropical.

Proposers are encouraged to indicate in their proposals what kinds of ground truth data would best enable their research and at which stage in the program they would need such data.

Proposals should be very specific, indicating desired

- spatial resolution, over what field of view;
- spectral resolution, over what wavelength bands;
- depth resolution, over what ranges;
- camera configurations;
- movement resolution or the distance the vehicle-mounted measurement systems are moved between measurements and/or;
- ancillary data such as visible or near-infrared imagery of the scene (be specific).

Proposals should clearly delineate data requirements versus data requests. After the start of the program, the Government T&E Team will work with performer(s) to optimize the Government Furnished Information (GFI) collected to maximize the chances of program success. DARPA reserves the right to determine which data requirements and requests will be collected and supplied to performer teams as GFI.

The Government T&E Team will be responsible for disseminating the ground truth data. The database is expected to be petabytes in size. Therefore, proposers should account in their proposals for the necessary costs to accept, store, and use this volume of data.

The Government T&E Team may choose to prepare two separate ground truth databases. In this case, the primary database will be export-controlled and will be disseminated to performers eligible to receive export-controlled data (see Section III.D for eligibility requirements and proposal instructions related to eligibility). A secondary database will be derived from the

primary database and will not be export-controlled. DARPA is not responsible for any resulting programmatic disadvantage, real or perceived, resulting from ineligibility to access export-controlled data.

F. Technical Area Descriptions

The Invisible Headlights program is divided into two Technical Areas (TAs).

1. Technical Area 1 (TA 1) – Near-Term Passive 3D Vision

TA 1 will focus on modifying and extending existing sensors and developing related processing and perception techniques to enable passive 3D vision for autonomous navigation. At program kickoff, state-of-the-art sensors will be “3rd Generation FLIR.” These sensors have large focal plane arrays, fast update rates, shot-noise-limited performance, and either single-band or few-band frequency sensitivity in the mid-wave-infrared (MWIR) or long-wave-infrared (LWIR). Proposers to TA 1 are encouraged to explore the utility of these state-of-the-art sensors as well as other lower-cost, lower-performance sensors. Sensor variety will enable the program to determine exactly how 3D vision performance scales with sensor quality in this regime.

Proposers are encouraged to propose novel methods for achieving passive 3D vision. Performer(s) in TA 1 are not required to tie their approach to increased measurement diversity (i.e., measuring more colors, spatial modes, and polarizations); any effective technical approach that can meet the program metrics (see metrics in Section I.G) will be considered. Success in TA 1 would enable a near-term, totally passive 3D vision system for off-road autonomous ground vehicles traveling at speeds nominally up to 25 mph.

Because performer approaches are expected to be technically diverse, proposers are permitted to propose their own schedule of technical and programmatic milestones that support achieving the required program metrics. All proposals to TA 1 are, however, required to address the following essential questions:

- Which existing sensors will be modified as part of this program? What are their relevant specifications? Be specific and complete.
- How will these sensors be modified? What are the time and schedule implications of these modifications?
- What key design decisions do you expect will be necessary at what point in the program?
- What assumptions are you making about the thermal environment? Which assumptions are required for success?
- What are the limits of your approach?

Sensors that require cooling to as low as 77 K are allowed as part of TA 1, although proposers that wish to explore this type of cooled detector are encouraged to also explore less expensive, lower size, weight, and power (SWaP), higher temperature systems, in order to be able to validate the virtual tradespace in a different regime.

Specifically discouraged are proposals that focus effort on real-time data processing at the expense of accomplishing the primary program goals. Real-time data processing is not required

as part of this program, although real-time measurement is required for some of the program milestones. In other words, for some program milestones, data must be collected quickly (in real time), but the algorithms that transform that data into 3D maps of the environment can be executed offline and at a much slower speed. Development of vehicle autonomy algorithms is not a part of this program; efforts should instead focus on developing passive 3D vision with metrics inspired from ground-based autonomy.

2. Technical Area 2 (TA 2) – Novel Sensors for Measurement Hyperdiversity

TA 2 will focus on creating completely new types of sensors capable of measurement hyperdiversity, which is defined here as “capable of performing a number of measurements per second that exceeds the state of the art by multiple orders of magnitude.”

A single measurement is defined here as the incident photons/time (or equivalently, optical power) that fall within a defined spatial or frequency bandwidth and polarization. A single measurement could be a single quantum mode or the sum of many such modes. For example, a polarization-insensitive, Megapixel-size, broadband-LWIR focal plane array operating at a frame rate of 500 Hz would perform 5×10^8 measurements/second. If the same device was modified such that every pixel registered 1000 different color bands and two different polarizations, it would perform 10^{12} measurements/second. This example is included for illustrative purposes only and not as a recommended approach. Each proposal should outline a specific approach and combination of measurement techniques that are expected to achieve measurement hyperdiversity.

3D vision that enables high-speed autonomous navigation is expected to require measurement hyperdiversity for the following reasons:

- Minimum stopping distance, and, therefore, required vision distance scale quadratically with speed.
- Higher vision distances imply much higher angular resolution over the same field of view.
- Some 3D vision techniques (e.g., triangulation-based ranging) require increased contrast for feature detection; spectral and polarization diversity are both ways to increase contrast.
- Some 3D vision techniques (e.g., atmospheric-absorption-based ranging) require very high levels of spectral resolution.
- All 3D vision techniques are signal-to-noise ratio (SNR) limited, and increased measurement diversity has the potential to increase SNR in scenes containing high levels of non-redundant information.

TA 2 proposers are not required to propose any particular photon detection technology, but the following detector characteristics are expected to be required to achieve useful signals from measurement hyperdiverse detectors:

- Near-zero levels of noise (e.g., dark counts, read noise, amplifier noise, etc.)
- Very high quantum efficiency, possibly near 100%

- Sensitivity in MWIR and/or LWIR
- A plausible path towards very large detector arrays and very high measurement rates

Initial modeling shows that in order to achieve ground vehicle speeds as high as 75 mph, sensors capable of making $\sim 10^{12}$ measurements per second will be needed. All proposers to TA 2 are required to show how their proposed technology can reach this level of measurement hyperdiversity by the end of the program.

Because of the extremely high data bandwidth for a sensor capable of making 10^{12} measurements per second, TA 2 proposers must describe a realistic plan to create a system that can reduce input data in real time to the essential information that enables 3D vision. For example, a particular sensor might measure many wavelength bands but dynamically select a subset of bands that are actually processed during one particular unit of time. Solutions creating a massive amount of data that cannot realistically be used are not of interest.

Fundamental research activities are appropriate for proposal to TA 2, including technologies that require, for example, high SWaP and/or cryogenic cooling. As long as proposers can successfully argue that a candidate technology can meet the program metrics, no specific levels of performance are required to have been achieved at the time of proposal submission. Although TA 2 metrics are derived from ground-based autonomous systems, success could impact a variety of future applications in autonomy and sensing. Proposers are encouraged to point out where their proposed technology could have a broader transformative impact.

Because performer approaches are expected to be technically diverse, proposers are permitted to propose their own schedule of technical and programmatic milestones that support achieving the required program metrics. All proposals to TA 2 are required to address the following questions:

- What is the state of the art for the type of sensor you wish to explore?
- What is the path you expect to take to advance this detection system from the current state of the art to the required program milestones?
- What is the anticipated noise performance of your proposed system, and can this level of noise support the required level of measurement hyperdiversity required at the end of Phase 3, while still achieving a useful signal to noise ratio?
- What is your technical strategy for measurement hyperdiversity?
- Is your detector a photon counting system?
- Describe the path, if any, to take your system to a low-SWaP, fieldable device after the completion of the program?
- What is the bandwidth over which your detector technology is sensitive?
- What key design decisions do you expect will be necessary at what point in the program?
- What assumptions are you making about the thermal environment? Which assumptions are required for success?
- What are the limits of your approach?

Sensors that require cooling to as low as 1 K are allowed as part of TA 2. No explicit SWaP requirements are included for TA 2. Sensor technologies that are at a research and development

stage are explicitly allowed as part of TA 2, as long as they have the potential to be transformative if successful and there is a path to achieving the required program milestones.

Real-time data processing is not required as part of this program, although real-time measurement is required for some of the program milestones. Development of vehicle autonomy algorithms is not a part of this program; efforts instead focus on developing passive 3D vision with metrics inspired from ground-based autonomy.

3. Virtual Tradespace Exploration

Performers in both TAs 1 and 2 will be required to explore and characterize the tradespace of achievable 3D vision performance as a function of infrared sensor specifications. Using the ground truth database filtered through a virtual sensor, performers will demonstrate the efficacy of widely varying approaches by characterizing 3D vision performance as a function of the virtual sensor space.

The tradespace of 3D vision performance as a function of sensor specifications is a huge, multi-dimensional space that relies on a hyper-spectral-resolution, high-spatial-resolution, multi-polarization scene. Performers will be expected to develop advanced techniques for quantifying, visualizing, and understanding the thermal environment along a given route. Similarly, they will be expected to develop advanced techniques for quantifying, visualizing, and understanding the tradespace of 3D vision performance as a function of environment and sensor specifications. Performers will be required to optimize the tradespace in order to minimize the number of required measurements to achieve a given performance, as well as to minimize the data bandwidth from the detection system to a virtual data processing system.

The goal of the virtual tradespace study is distinct from the effort in each TA; it should help reveal the spectrum of possible approaches, rather than examining one approach in detail. A specific technology proposed under TA 1 or TA 2 may fit inside this tradespace, but the tradespace itself is expected to be much larger. The study must help illuminate the fundamental limits that physics imposes on the problem and the space of possible approaches.

All performers are required to produce increasingly robust and useful virtual tradespace algorithms as the program progresses. Three broad classes of virtual tradespaces are described below, characterized by the types of independent and dependent variables they support. Performers are required to develop examples of each class of tradespace on the schedule listed in Table 1 below. Proposers should assemble a team with the necessary expertise to execute towards these goals, and provide a clear plan to address the virtual tradespace program goals.

Point-Design Virtual Tradespace. This class of virtual tradespace algorithms predicts the vehicle speed enabled by a specific sensor design and specific sensor configuration used in a specific type of environment. Because the experimental systems investigated in each TA are so different, it is anticipated they will provide valuable complementary experimental tests of the Point-Design Virtual Tradespace algorithms.

- Independent Variables (Inputs)
 - Sensor Specifications: To include measurement types, measurement rates, sensor noise profile, etc.

- Sensor Configuration: Sensor number and geometry. For example, two sensors in a stereo configuration 1.5 meters apart.
- Ambient Infrared Environment: As characterized by, for example, mean temperature, temperature variance, spectral contrast, etc.
- Dependent Variables (Outputs)
 - Achievable Vehicle Speed: What is the enabled autonomous vehicle speed? Assume a minimum stopping distance given by the “vision range” listed in Table 3.
 - 3D Vision Approach: What approach supports the reported vehicle speed? Examples include atmospheric-absorption-based reconstruction or stereo-based reconstruction.
 - Detailed Performance Metrics: What detailed 3D vision performance metrics support the reported vehicle speed? See Table 3 for an example of detailed metrics supporting a LIDAR-like reconstruction technique.

Multiple-Design Virtual Tradespace. This class of virtual tradespace algorithms predicts the optimal sensor design that maximizes achievable vehicle speed given certain design constraints.

- Independent Variables (Inputs)
 - Maximum Number of Measurements per Second: As defined in Section F.2. Assume the sensor must always perform the same measurements.
 - Sensor Noise Profile: Sensor noise associated with each measurement.
 - Maximum Data Bandwidth: Assume raw measurements must be compressed before data is transmitted to the central processing unit (CPU), and the data link connecting the detector to the CPU is limited by this value. This limitation approximates the design constraints imposed by real read-out integrated circuits (ROICs).
 - Sensor Configuration: Sensor number and geometry. For example, two sensors in a stereo configuration 1.5 meters apart.
 - Ambient Infrared Environment: As characterized by, for example, mean temperature, temperature variance, spectral contrast, etc.
- Dependent Variables (Outputs)
 - Sensor Measurements: Which measurements, specifically, optimize achievable vehicle speed within the given constraints?
 - Achievable Vehicle Speed: What is the enabled autonomous vehicle speed? Assume a minimum stopping distance given by the “vision range” listed in Table 3.
 - 3D Vision Approach: What approach supports the reported vehicle speed? Examples include atmospheric-absorption-based reconstruction or stereo-based reconstruction.
 - Detailed Performance Metrics: What detailed 3D vision performance metrics support the reported vehicle speed? See Table 3 for an example of detailed metrics supporting a LIDAR-like reconstruction technique.

Adaptive-Design Virtual Tradespace. This class of virtual tradespace algorithms predicts the optimal adaptive sensor strategy that maximizes achievable vehicle speed given certain design constraints.

- Independent Variables (Inputs)
 - Maximum Number of Adaptive Measurements per Second: Assume the sensor can dynamically adjust which measurements are performed from moment to moment, e.g., a sensor that always measures three color bands but is capable of dynamically adjusting the central frequencies of the three color bands.
 - Sensor Noise Profile: Sensor noise associated with each measurement.
 - Maximum Data Bandwidth: Assume raw measurements must be compressed before data is transmitted to the central processing unit (CPU), and the data link connecting the detector to the CPU is limited by this value. This limitation approximates the design constraints imposed by real ROICs.
 - Sensor Configuration: Sensor number and geometry. For example, two sensors in a stereo configuration 1.5 meters apart.
 - Ambient Infrared Environment: As characterized by, for example, mean temperature, temperature variance, spectral contrast, etc.
- Dependent Variables (Outputs)
 - Sensor Measurements: Which adaptive measurement strategy, specifically, optimizes achievable vehicle speed within the given constraints?
 - Achievable Vehicle Speed: What is the enabled autonomous vehicle speed? Assume a minimum stopping distance given by the “vision range” listed in Table 3.
 - 3D Vision Approach: What approach supports the reported vehicle speed? Examples include atmospheric-absorption-based reconstruction or stereo-based reconstruction.
 - Detailed Performance Metrics: What detailed 3D vision performance metrics support the reported vehicle speed? See Table 3 for an example of detailed metrics supporting a LIDAR-like reconstruction technique.

All proposals are required to address the following questions about the virtual tradespace exploration effort:

- What do you anticipate are the best metrics for characterizing the ambient infrared environment, specifically the metrics that should be used as the independent variables in a virtual tradespace? How do you expect to be able to quantify and visualize the information content in the ambient infrared environment?
- What 3D vision approaches do you anticipate informing your virtual tradespace exploration? Stereo? Optical flow? Atmospheric-absorption-based? Other?
- What are the specific 3D reconstruction metrics that you will use to support a specific vehicle speed in the tradespace? See Table 3 for a LIDAR-based example.
- What alternate approaches to 3D reconstruction will you pursue? For example, do you anticipate being able to leverage 3D semantic scene segmentation to understand a scene without first creating a LIDAR-like point cloud?
- How do you believe the approaches you are considering will be fundamentally limited by temperature variation in the scene? Hyperspectral contrast in the scene? Geometry of the scene?
- Are there other fundamental limits you believe impact this problem?

Collaborative efforts/teaming are strongly encouraged, especially considering the multidisciplinary nature of the expected research. Success in this area will result in new autonomous algorithms for deriving desired sensor specifications for specific tasks; for example, a Multiple-Design Virtual Tradespace algorithm could derive the ideal three frequency bands for enabling 30-mph 3D vision in arctic environments, given a particular focal plane array size and sensor noise profile.

4. Proposing to Multiple Technical Areas

Proposers wishing to propose to multiple Technical Areas must submit separate technical and cost proposals for each. Proposers should not submit proposals that combine multiple Technical Areas into a single effort; **DARPA may deem proposals that address multiple technical areas non-conforming and remove them from consideration.** Proposers should strive to provide a clear understanding of the cost, risk, and organizational expertise to be used within each proposed effort.

G. Schedule/Milestones

Performers will be evaluated using a number of milestones and metrics as enumerated below. Attainment of the milestones and metrics for a given phase does not guarantee transition into the next phase of the program. Individual efforts will also be judged on their expected ability to have a transformative impact on DoD and DARPA priorities.

Virtual Tradespace Technical and Management Milestones

Proposers must define their own schedule of technical milestones needed to succeed at virtual tradespace exploration. At a minimum, performer(s) are expected to achieve the following milestones by the quarter-after-award indicated:

Table 1 – Virtual Tradespace Exploration Milestones (TA 1 and TA 2)

Quarter After Award	Milestone
Phase 1	
1	N/A
2	Quantify/visualize information content in thermal scenes
3	Initial virtual sensor implementation
4	Demonstrate first Point-Design Virtual Tradespace
5	Prepare detailed priority list for Phase 2 ground truth measurements based on tradespace results
6	Demonstrate first Multiple-Design Virtual Tradespace
Phase 2	
7	N/A
8	Demonstrate first Adaptive-Design Virtual Tradespace
9	N/A

10	Generate tradespaces tailored to Government-team custom goals (e.g., different modes of autonomy)
11	N/A
12	Deliver improved Point-Design, Multiple-Design, and Adaptive-Design Virtual Tradespaces informed by both improved ground truth databases and more advanced performer algorithms
13	Work with Government stakeholders and transition partners to maximize impact of developed technologies; continue to optimize algorithms
Phase 3	
14-19	Required milestones for Phase 3 will be detailed in Phase 3 proposal instructions issued near the end of Phase 2. For estimating ROM costs, please use the milestones illustrated in Figure 2.

TA 1 and TA 2 Technical and Management Milestones

Performer(s) are required to characterize the information content of ambient infrared emissions and to exploit that information for 3D vision. Achievable 3D vision performance is correctly characterized by a number of detailed performance metrics that depend on the specific approach a performer uses to achieve 3D vision. For a LIDAR-like approach, these metrics would include 3D vision distance, transverse resolution, longitudinal resolution (i.e., ranging accuracy), update rate, and points per update. For an approach based on, for example, developing a semantic understanding of the scene, the detailed metrics could be quite different.

Proposers are required to clearly show how their preferred detailed performance metrics support the speeds listed in Table 2. The achievable vehicle speed metric will be used to characterize the experimental systems created in TAs 1 and 2. Table 2 shows the required metrics for each key program element, using these definitions:

- Mobile 3D Vision** Sensing that is performed from a continuously moving vehicle.
- Stationary 3D Vision** Sensing that is performed from a vehicle that occupies a series of stopped positions. The vehicle can stop at a location, sense for as long as required, then move to a new position. Note that in this way, even 3D reconstruction techniques that leverage motion, such as optical flow, can be simulated using “stationary” measurements.

Table 2 – Technical Milestones for TA 1 and TA 2

Milestone	Phase 1	Phase 2	Phase 3
<u>TA 1: Near-Term Passive 3D Vision</u>			
Stationary 3D Vision @ distance / resolutions supporting listed speed	25 mph		
Stationary 3D Vision @ distance / resolutions / time supporting listed speed		25 mph	
Mobile 3D Vision @ listed speed		10 mph	25 mph

Demonstrate that operationally relevant SWaP is feasible			YES
TA 2: Novel Sensors for Measurement Hyperdiversity			
Stationary 3D Vision @ distance / resolutions supporting listed speed		35 mph	
Stationary 3D Vision @ distance / resolutions / time supporting listed speed			50 mph
Mobile 3D Vision @ listed speed			10 mph
Demonstrate that it is feasible to scale sensor to listed measurement diversity / 3D vision speed	50 mph; 10¹² meas. / s		
Demonstrate listed measurement diversity in real sensor		10⁹ meas. / s	10¹² meas. / s

The single-parameter “speed” metric used in Table 2 above is used to summarize a much more complex tradespace. Faster autonomous vehicle speeds impose much more stringent requirements on a supporting 3D vision system, including longer vision distances and more 3D points per update.

Table 3 below shows an example set of performance metrics needed to support various vehicle speeds, assuming a LIDAR-like approach. Proposers are required to provide a similar chart listing detailed performance metrics for their system that support all of the vehicle speeds listed below. Proposers may assume a 3D vision approach is sufficient if it supports a minimum reactive autonomy stopping distance equal to the “vision range” metric in Table 3. The single metric “stopping distance” is used for simplicity, instead of a much more complex set of potential autonomy requirements (e.g., planning distance, turning distance, etc.). This is because Invisible Headlights is focused on passive 3D vision, not on better autonomy algorithms.

Note the physical sensors developed in TA 1 and TA 2 are not required to support all the speeds listed in Table 3, but proposers should still provide detailed performance metrics for all of these speeds in order to clearly communicate the implications of their approach to 3D vision.

Table 3 – Example Relationship between Speed and 3D Vision Metrics for a LIDAR-like 3D Reconstruction Approach

Detailed Metric	10 mph	25 mph	35 mph	50 mph	75 mph	100 mph
Vision Range	5 m	20 m	40 m	80 m	180 m	320 m
Longitudinal Resolution / Range	1%					
Transverse Resolution	0.1 m					

Measurement Time / Update	100 ms					
	(Note that while proposers may assume that a 3D model of the world does not need to be updated more frequently than every 100 ms, at high speeds individual measurements will likely need to be taken much faster in order to mitigate the negative effects of motion blur)					
Points / Update	2.5k	100k	400k	1,600k	8,000k	25,000k

Demonstrations and Experiments

The Invisible Headlights program will assess success throughout the program using a series of demonstrations at performer-chosen sites and/or DARPA-specified sites. The goal of the demonstrations is to assess system performance and the candidate technologies’ potential to meet the program milestones and metrics.

- Proposals should describe proposers’ plans for testing their systems at their own laboratory and/or other “proving grounds” of their choice. If a proposer desires to conduct testing or demonstration at a commercial or Government facility, the proposer must include those costs as part of their proposal in accordance with the proposal instructions.
- Demonstrations at performer-chosen sites are expected to be one day in length.
- Demonstrations at DARPA-specified sites will exercise the system at a field location. It is likely that the sites to be used will be the same locations collected in the ground truth database, which will allow comparison of real-world and virtual system performance. Proposals should include costs for travel for one day of demonstration and as many days beforehand that the team requires to prepare. For planning purposes, proposer(s) may assume that one experiment will occur at each of the following locations: Twentynine Palms, CA and Fort A.P. Hill, VA.

Other proposal properties

- Proposers should provide a technical and programmatic strategy that conforms to the entire program schedule and presents an aggressive plan to fully address all program goals, metrics, milestones and deliverables.
- The task structure must be consistent across the proposed Schedule, Statement of Work, and Cost Volume.
- A target start date of October 1, 2020 may be assumed for planning purposes.
- Schedules will be synchronized across performer(s), as required, and monitored/revised as necessary throughout the program.
- All proposals must include the following meetings and travel in the proposed schedule and costs:
 - To continue integration and development between TAs, foster collaboration between teams, and disseminate program developments, multiple two-day Principal Investigator (PI) meetings will be held in each phase, with locations split between the East and West Coasts of the United States. For budgeting purposes, plan for four (4) two-day meetings over the course of Phase 1 and Phase 2: two (2) meetings in the Washington, D.C. area and two (2) meetings in the San Francisco, CA area. The kickoff meetings should be budgeted for

Embedded Entrepreneur participants will work closely with DARPA's Commercial Strategy team and their extensive network of U.S. investors, strategic partners, and mentors.

Proposers wishing to be considered for participation in the Embedded Entrepreneur Initiative must:

- Include an initial hypothesis describing how the proposed technology will transition from its current state to future integration into a product or capability.
- Include a separately costed option in the provided cost proposal template not to exceed \$250,000 that includes tasks describing plans to build and refine a viable Go to Market Strategy over the course of the DARPA program. Tasks contributing to the build of a robust Go to Market Strategy can include, but are not limited to; cost modeling, end user engagement, market analysis and mapping, competitive analysis, techno-economic analysis, manufacturing and scale-up strategy, IP securement strategy, and financial plan creation. These EEI tasks and deliverables must be provided as an option in the Statement of Work submitted in response to this BAA.
- The DARPA EEI option will be exercised at the discretion of the Government based on a performer's technical accomplishments and progress towards development of a technology with transition and commercialization potential and subject to the availability of funding.

Participation in the Embedded Entrepreneur Initiative is voluntary but highly recommended.

Participants are not expected to form a new company or leave their current research positions to pursue transition, but are expected to, throughout the lifecycle of the proposed effort, identify appropriate partners for enabling transition. Embedded Entrepreneur Initiative funding requests should be consistent with the proposed work scope and proposed timeline, but are anticipated to be in the range of \$250,000 per Performer.

I. Deliverables

Performer(s) will be expected to provide at a minimum the following deliverables:

- Comprehensive quarterly technical reports due within ten days of the end of the given quarter, describing progress made on the specific milestones as laid out in the SOW.
- A phase completion report submitted within 30 days of the end of each phase, summarizing the research performed.
- Reports, briefings, media, etc. to document the results of virtual sensor testing and tradespace exploration.
- Source code for the algorithms used to quantify, explore, and visualize the virtual sensor tradespace. Source code should be well-documented and follow industry best practices for readability.
- Reports, briefings, media, etc. to document the results of live field experimentation.
- Other negotiated deliverables specific to the objectives of the individual efforts. These may include registered reports, experimental protocols, publications, data management plan, intermediate and final versions of software libraries, code, and APIs, including documentation and user manuals, and/or a comprehensive assemblage of design documents, models, modeling data and results, and model validation data.
- Reporting as outlined in Section VI.C.

Any Controlled Unclassified Information (CUI) or Controlled Technical Information (CTI) must be marked as described in Section III.D.1.

J. Other Program Objectives and Considerations

1. Collaboration

Throughout the course of the program, it will be necessary for performers—regardless of category—to share relevant information regarding their research and development to support the larger program goals. DARPA expects all performers to work collaboratively with one another to realize the program objectives outlined herein, so proposers should carefully review the goals for the entire program in order to fully understand the context of each program objective, performer category, and TA within the overall program structure. All proposals should describe plans for ensuring transparency of their processes to enable interactions with other program performers. Proposals that fail to include these plans may be deemed non-conforming and removed from consideration.

2. Intellectual Property

For the virtual tradespace exploration focus of the program, there is an emphasis on creating and leveraging open source technologies and architectures, making data sharing and collaboration key aspects of this program. Therefore, intellectual property rights asserted by proposers are strongly encouraged to be aligned with open source regimes. See Section VI.B.4 for more information related to intellectual property.

II. Award Information

A. General Award Information

DARPA anticipates multiple awards.

The level of funding for individual awards made under this BAA 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;

¹ As used throughout this BAA, “proposer” refers to the lead organization on a submission to this BAA. The proposer is responsible for ensuring that all information required by a BAA—from all team members—is submitted in accordance with the BAA. “Awardee” refers to anyone who might receive a prime award from the Government, including recipients of procurement contracts, cooperative agreements, or Other Transactions. “Subawardee” refers to anyone who might receive a subaward from a prime awardee (e.g., subawardee, consultant, etc.).

- 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 procurement contract, cooperative agreement, or other transaction (OT), depending upon the nature of the work proposed, the required degree of interaction between parties, and other factors.

Proposers looking for innovative, commercial-like contractual arrangements are encouraged to consider requesting Other Transactions. To understand the flexibility and options associated with Other Transactions, consult <http://www.darpa.mil/work-with-us/contract-management#OtherTransactions>.

In accordance with 10 U.S.C. § 2371b(f), the Government may award a follow-on production contract or Other Transaction (OT) for any OT awarded under this BAA if: (1) that participant in the OT, or a recognized successor in interest to the OT, successfully completed the entire prototype project provided for in the OT, as modified; and (2) the OT provides for the award of a follow-on production contract or OT to the participant, or a recognized successor in interest to the OT.

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

Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to determine whether the proposed research shall be considered fundamental and to select the award instrument type. Appropriate language will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate. This language can be found at <http://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 non-fundamental research, its proposed subawardee's effort may be fundamental research. It is also possible that the research performed by a potential awardee is fundamental research while its proposed subawardee's effort may be non-fundamental research. In all cases, it is the potential awardee's responsibility to explain in its proposal which proposed efforts are fundamental research and why the proposed efforts should be considered fundamental research.

III. Eligibility Information

A. Eligible Applicants

All responsible sources capable of satisfying the Government's needs may submit a proposal for DARPA's consideration.

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 BAA in any capacity unless they meet the following conditions. (1) FFRDCs must clearly demonstrate that the proposed work is not otherwise available from the private sector. (2) FFRDCs must provide a letter, on official letterhead from their sponsoring organization, that (a) cites the specific authority establishing their eligibility to propose to Government solicitations and

compete with industry, and (b) certifies the FFRDC's compliance with the associated FFRDC sponsor agreement's terms and conditions. These conditions are a requirement for FFRDCs proposing to be awardees or subawardees.

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 and compete with industry. This information is required for Government Entities proposing to be awardees or subawardees.

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 <https://www.dcsa.mil/mc/ctp/foci/>.

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 each proposal submitted to the BAA. 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 BAA 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.

Include any OCIs affirmations and disclosures in Attachment G Proposal Template Vol. 3-Admin and National Policy Requirements_Amendment 1.

C. Cost Sharing/Matching

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

For more information on potential cost sharing requirements for Other Transactions for Prototype, see <http://www.darpa.mil/work-with-us/contract-management#OtherTransactions>.

D. Other Eligibility Requirements

1. Controlled Unclassified Information (CUI) and Controlled Technical Information (CTI) on Non-DoD Information Systems

Proposers and awardees may be subject to DoD requirements related to CUI or CTI on Non-DoD Information Systems as detailed at www.darpa.mil/work-with-us/additional-baa.

It is anticipated that TA 1 requires access to Export-Controlled information and technology. As a result, TA 1 performers are required to comply with DoD requirements related to CUI. Proposers should indicate in their proposal if their proposed solution includes CUI. All TA 1 proposals indicating CUI requirements must include a draft CUI protection plan detailing how CUI will be protected at performer sites as well as at subcontractor locations. The draft CUI protection plan is not a source selection criteria, and there is no page limit. During selection and negotiation, DARPA will determine additional requirements and clarification required of the CUI protection plan.

TA 2 is not expected to require access to Export-Controlled information or technology. However, proposers to TA 2 who wish to be eligible to work with Export-Controlled Information and Technology must submit a Security Plan detailing their eligibility as part of their proposal. Proposers to TA 2 who are eligible to work with Export-Controlled Information and who submit an approved Security Plan may be eligible to work with Export-Controlled Government-Furnished Information as part of their Virtual Tradespace Exploration tasking. For proposers to TA 2 who wish to perform Export-Controlled virtual tradespace exploration, only those personnel who will have access to, use, manage, or interact with Export-Controlled Information are required to be US Persons, if allowed by an approved CUI protection plan.

CUI is defined as unclassified technical information that requires safeguarding or dissemination controls, pursuant to and consistent with applicable law, regulations, and Government-wide policies.

DoD considers “technical information” to be technical data or computer software, as those terms are defined in Defense Federal Acquisition Regulation Supplement clause 252.227-7013, "Rights in Technical Data - Noncommercial Items" (48 CFR 252.227-7013). Examples of technical information include research and engineering data, engineering drawings, and associated lists, specifications, standards, process sheets, manuals, technical reports, technical orders, catalog-item identifications, data sets, studies and analyses and related information, and computer software code. Note that such technical information may or may not be controlled (i.e., CTI), depending on whether it has military or space application.

CUI is to be marked “DISTRIBUTION C. Distribution authorized to U.S. Government agencies and their contractors; Critical Technology; Current date. Other requests for this document shall be referred to DARPA, DSO” in accordance with Department of Defense Instruction 5230.24, "Distribution Statements on Technical Documents."

All printed and electronic, including digital, technical documents that are determined to contain

export-controlled technical data shall be marked as follows:

WARNING - This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751, et seq.) or the Export Administration Act of 1979 (Title 50, U.S.C., App. 2401 et seq.), as amended. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25.

Proposers should provide a plan for protecting Controlled Unclassified Information that may be generated during Invisible Headlights as part of Attachment G: Proposal Template Volume 3 Administrative & National Policy Requirements Volume_Amendment 1.

IV. Application and Submission Information

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

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

Abstracts and full proposals that are not found to be applicable to the Invisible Headlights BAA as defined above may be deemed non-conforming² and removed from consideration. All abstracts and full proposals must provide sufficient information to assess the validity/feasibility of their claims as well as comply with the requirements outlined herein for submission formatting, content and transmission to DARPA. Abstracts and full proposals that fail to do so may be deemed non-conforming and removed from consideration. Proposers will be notified of non-conforming determinations via letter.

A. Address to Request Application Package

This document contains all information required to submit a response to this solicitation. No additional forms, kits, or other materials are needed except as referenced herein. No request for proposal or additional solicitation regarding this opportunity will be issued, nor is additional information available except as provided at the beta.SAM.gov website (<https://beta.sam.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. Abstract Information

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

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

DARPA will respond to abstracts with a statement as to whether DARPA is interested in the idea. If DARPA does not recommend the proposer submit a full proposal, DARPA will provide feedback to the proposer regarding the rationale for this decision. Regardless of DARPA's response to an abstract, proposers may submit a full proposal. DARPA will review all conforming full proposals using the published evaluation criteria and without regard to any comments resulting from the review of an abstract.

Proposers should note that a favorable response to an abstract is not a guarantee that a proposal based on the abstract will ultimately be selected for award negotiation.

While it is DARPA policy to attempt to reply to abstracts within thirty calendar days, proposers to this solicitation may anticipate a response within approximately three weeks. These official notifications will be sent via email to the Technical POC and/or Administrative POC identified on the abstract coversheet.

- **Abstract Format**

All proposers are required to use Attachment A: Abstract Summary Slide Template and Attachment B: Abstract Template provided to this solicitation on <https://beta.sam.gov/> and <http://www.grants.gov>. Attachment A Abstract Summary Slide Template described herein must be in .ppt or .pptx format and should be attached as a separate file to this document.

2. Full Proposal Information

Proposals consist of Volume 1: Technical and Management Volume, Volume 2: Cost Volume, and Volume 3: Administrative and National Policy Requirements Volume).

To assist in proposal development, various attachments have been provided along with the BAA posted on <https://beta.sam.gov/> (Attachment C: Proposal Summary Slide Template, Attachment D: Proposal Template Volume 1 Technical & Management Volume, Attachment E: MS Excel™ DARPA Cost Proposal Spreadsheet, Attachment F: Proposal Template Volume 2 Cost Volume_Amendment 1 and Attachment G: Proposal Template Volume 3 Administrative &

National Policy Requirements Volume_Amendment 1).

Full proposals requesting a procurement contract or other transaction (OT) must use the following attachments:

- Attachment C
- Attachment D
- Attachment F_Amendment 1
- Attachment G_Amendment 1

Proposers requesting a procurement contract or other transaction (OT) are also strongly encouraged to use the following attachment:

- Attachment E (MS Excel™ DARPA cost proposal spreadsheet).

Full proposals requesting a cooperative agreement must use the following attachments in addition to the Grants.gov application package:

- Attachment C
- Attachment D
- Attachment G_Amendment 1

Proposers requesting a cooperative agreement are also strongly encouraged to use the following attachment:

- Attachment E (MS Excel™ DARPA cost proposal spreadsheet).

*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.

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

- **Full Proposal Format**

All proposers are required to use the templates provided as attachments to this solicitation on <https://beta.sam.gov/> and <http://www.grants.gov>. Formatting instructions are provided therein.

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.4 for additional information.

4. Security Information

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

Security classification guidance and direction via a 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 BAA Administrator at InvisibleHeadlights@darpa.mil to verify receipt.

1. Abstracts

Abstracts 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. Abstracts received after this time and date may not be reviewed.

2. Full Proposals

Full proposal packages--full proposal (Volume 1: Technical and Management Volume, Volume 2: Cost Volume, and Volume 3: Administrative and National Policy Requirements Volume) 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

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. Abstracts

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

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

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

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

Technical support for the DARPA BAA Submission website is available during regular business hours, Monday – Friday, 9:00 a.m. – 5:00 p.m. Requests for technical support must be emailed to BAAT_Support@darpa.mil with a copy to InvisibleHeadlights@darpa.mil. Questions regarding submission contents, format, deadlines, etc. should be emailed to InvisibleHeadlights@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 abstracts are due to request an account and/or upload the submission.

Note: Proposers submitting an abstract via the DARPA BAA Submission site 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 Procurement Contract or Other Transaction

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

i. Electronic Upload

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

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

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

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

Technical support for the DARPA BAA Submission website is available during regular business hours, Monday – Friday, 9:00 a.m. – 5:00 p.m. Requests for technical support must be emailed to BAAT_Support@darpa.mil with a copy to InvisibleHeadlights@darpa.mil. Questions regarding submission contents, format, deadlines, etc. should be emailed to InvisibleHeadlights@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 proposals are due to request an account and/or upload the submission. Note: Proposers submitting a proposal via the DARPA BAA Submission site 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.

ii. Direct Mail/Hand-carry

Proposers electing to submit procurement contract or other transaction 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. All parts of the proposal package must be mailed or hand-carried in a single delivery to the address noted in Section VII below.

c. Proposals Requesting a Cooperative Agreement

Proposers requesting cooperative agreements must submit proposals through ONE of the following methods: (1) electronic upload per the instructions at <https://www.grants.gov/applicants/apply-for-grants.html>; or (2) hard-copy mailed directly to DARPA. If proposers intend to use Grants.gov as their means of submission, then they must submit their entire proposal through Grants.gov; applications cannot be submitted in part to Grants.gov and in part as a hard-copy. Proposers using Grants.gov do not submit hard-copy proposals in addition to the Grants.gov electronic submission.

Submissions: Proposers must submit the three forms listed below.

Form 1: SF 424 Research and Related (R&R) Application for Federal Assistance, available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_SF424_2_0-V2.0.pdf. This form must be completed and submitted.

To evaluate compliance with Title IX of the Education Amendments of 1972 {20 U.S.C. A§ 1681 Et. Seq.}, the Department of Defense is collecting certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in science, technology, engineering or mathematics disciplines. In addition, the National Defense Authorization Act (NDAA) for FY 2019, Section 1286, directs the Secretary of Defense to protect intellectual property, controlled information, key personnel, and information about critical technologies relevant to national security and limit undue influence, including foreign talent programs by countries that desire to exploit United States’ technology within the DoD research, science and technology, and innovation enterprise. This requirement is necessary for all research and research-related educational activities. The DoD is using the two forms below to collect the necessary information to satisfy these requirements. Detailed instructions for each form are available on Grants.gov.

Form 2: Research and Related Senior/Key Person Profile (Expanded), available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_KeyPersonExpanded_2_0-V2.0.pdf. This form must be completed and submitted.

The Research and Related Senior/Key Person Profile (Expanded) form will be used to collect the following information for all senior/key personnel, including Project Director/Principal

Investigator and Co-Project Director/Co-Principal Investigator, whether or not the individuals' efforts under the project are funded by the DoD:

- Degree Type and Degree Year.
- Current and Pending Support, including:
 - A list of all current projects the individual is working on, in addition to any future support the individual has applied to receive, regardless of the source.
 - Title and objectives of the other research projects.
 - The percentage per year to be devoted to the other projects.
 - The total amount of support the individual is receiving in connection to each of the other research projects or will receive if other proposals are awarded.
 - Name and address of the agencies and/or other parties supporting the other research projects
 - Period of performance for the other research projects.

Additional senior/key persons can be added by selecting the “Next Person” button at the bottom of the form. Note that, although applications without this information completed may pass Grants.gov edit checks, if DARPA receives an application without the required information, DARPA may determine that the application is incomplete and may cause your submission to be rejected and eliminated from further review and consideration under the BAA. DARPA reserves the right to request further details from the applicant before making a final determination on funding the effort.

Proposers requesting Cooperative Agreements are not required to complete the Representations Regarding Proposed Key Personnel section in Attachment G: Volume 3: Administrative and National Policy Requirements Document Template_Amendment 1, if Form 2 is completed and submitted as part of their application through Grants.gov.

Form 3: Research and Related Personal Data, available on the Grants.gov website at https://apply07.grants.gov/apply/forms/sample/RR_PersonalData_1_2-V1.2.pdf. *Each applicant must complete the name field of this form, however, provision of the demographic information is voluntary. Regardless of whether the demographic fields are completed or not, this form must be submitted with at least the applicant’s name completed.*

i. Electronic Upload

DARPA encourages cooperative agreement proposers to submit their proposals via electronic upload at <http://www.grants.gov/web/grants/applicants/apply-for-grants.html>. Proposers electing to use this method must complete a one-time registration process on Grants.gov before a proposal can be electronically submitted. *If proposers have not previously registered, this process can take 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 cooperative agreement 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 BAA 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 bolster the national security technology base, and support DARPA's mission to make pivotal early technology investments that create or prevent technological surprise. The proposed intellectual property restrictions (if any) will not significantly impact the Government's ability to transition the technology.

- **Cost Realism**

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

- **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 BAA mailbox, provided the formal request is received within 5 days after being notified of submission status.

C. Federal Awardee Performance and Integrity Information (FAPIS)

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 FAPIS). Selectees have the opportunity to comment on any information about themselves entered in the database. DARPA will consider any comments and other information in FAPIS 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 BAAs 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 cooperative agreements, see the DoD General Research Terms and Conditions (latest version) at <http://www.onr.navy.mil/Contracts-Grants/submit-proposal/grants-proposal/grants-terms-conditions> and the supplemental DARPA-specific terms and conditions at <http://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) 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 <http://www.darpa.mil/work-with-us/additional-baa> for further information.

International entities can register in SAM by following the instructions in this link: https://www.fsd.gov/fsd-gov/answer.do?sysparm_kbid=dbf8053adb119344d71272131f961946&sysparm_search=KB0013221.

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 4.1102 and 4.1201, proposers requesting a procurement contract must complete electronic annual representations and certifications at <https://www.sam.gov/>. In addition, resultant procurement contracts will require supplementary DARPA-specific representations and certifications. See <http://www.darpa.mil/work-with-us/additional-baa> for further information.

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 DARPA sponsorship.

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

implementing their approach may be required to indemnify the Government against legal liability arising from such use.

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

a. Intellectual Property Representations

All proposers must provide a good faith representation of either ownership or possession of appropriate licensing rights to all other intellectual property to be used for the proposed project. Proposers must provide a short summary for each item asserted with less than unlimited rights that describes the nature of the restriction and the intended use of the intellectual property in the conduct of the proposed research.

b. Patents

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

c. Procurement Contracts

- **Noncommercial Items (Technical Data and Computer Software):** Proposers requesting a procurement contract must list all noncommercial technical data and computer software that it plans to generate, develop, and/or deliver, in which the Government will acquire less than unlimited rights and to assert specific restrictions on those deliverables. In the event a proposer does not submit the list, the Government will assume that it has unlimited rights to all noncommercial technical data and computer software generated, developed, and/or delivered, unless it is substantiated that development of the noncommercial technical data and computer software occurred with mixed funding. If mixed funding is anticipated in the development of noncommercial technical data and computer software generated, developed, and/or delivered, proposers should identify the data and software in question as subject to GPR. In accordance with DFARS 252.227-7013, "Rights in Technical Data - Noncommercial Items," and DFARS 252.227-7014, "Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation," the Government will automatically assume that any such GPR restriction is limited to a period of 5 years, at which time the Government will acquire unlimited rights unless the parties agree otherwise. The Government may use the list during the evaluation process to evaluate the impact of any identified restrictions and may request additional information from the proposer, as may be necessary, to evaluate the proposer's assertions. Failure to provide full information may result in a determination that the

proposal is non-conforming. A template for complying with this request is provided in Section IV.B.2.

- **Commercial Items (Technical Data and Computer Software):** Proposers requesting a procurement contract must list all commercial technical data and commercial computer software that may be included in any noncommercial deliverables contemplated under the research project, and assert any applicable restrictions on the Government’s use of such commercial technical data and/or computer software. In the event a proposer does not submit the list, the Government will assume there are no restrictions on the Government’s use of such commercial items. The Government may use the list during the evaluation process to evaluate the impact of any identified restrictions and may request additional information from the proposer to evaluate the proposer’s assertions. Failure to provide full information may result in a determination that the proposal is non-conforming. A template for complying with this request is provided in Section IV.B.2.

d. Other Types of Awards

Proposers requesting an award instrument other than a procurement contract shall follow the applicable rules and regulations governing those award instruments, but in all cases should appropriately identify any potential restrictions on the Government’s use of any intellectual property contemplated under those award instruments. 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.c.

5. Program-generated Data

Data are increasingly the key product of research and engineering endeavors. To ensure the reproducibility of results and access to source data for future research, awardees will be required to maintain and deliver any data generated during award performance (“program-generated data”) that is needed to accomplish these goals. Awardees shall be expected to document both the proprietary and non-proprietary products of their research to ensure the retention and potential reusability of this information. This may include:

- Raw unprocessed data, software source code and executables, build scripts, process sequence, programmatic communication and other collaboration activities;
- Data sets: rarified, experimental, test and measurement data;
- Design of experiments and simulations;
- Models or simulations (computational or mathematical);
- Recordings of various physical phenomena (including images, videos, sensor data, etc.);
- Access to and use of institutional, organizational or scientific community repositories and archives

When possible, DARPA may share some or all of the program-generated data with the broader research community as open data (with permission to access, reuse, and redistribute under appropriate licensing terms where required) to the extent permitted by applicable law and regulations (e.g., privacy, security, rights in data, and export control). DARPA plans to enable reproducibility of results through data sharing and to establish (or contribute to) digital collections that can advance this and other scientific fields.

6. 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 <http://www.darpa.mil/work-with-us/additional-baa>, to include providing the information specified therein as required for proposal submission.

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 BAA.

8. Publication of Cooperative Agreement Awards

Per Section 8123 of the Department of Defense Appropriations Act, 2015 (Pub. L. 113-235), all cooperative agreement awards must be posted on a public website in a searchable format. To comply with this requirement, proposers requesting cooperative agreement 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 cooperative agreement proposals that are not selected for award will not be publicly posted.

9. Disclosure of Information and Compliance with Safeguarding Covered Defense Information Controls

The following provisions and clause apply to all solicitations and contracts; however, the definition of “controlled technical information” clearly exempts work considered fundamental research and therefore, even though included in the contract, will not apply if the work is fundamental research.

DFARS 252.204-7000, “Disclosure of Information”

DFARS 252.204-7008, “Compliance with Safeguarding Covered Defense Information Controls”

DFARS 252.204-7012, “Safeguarding Covered Defense Information and Cyber Incident Reporting”

The full text of the above solicitation provision and contract clauses can be found at <http://www.darpa.mil/work-with-us/additional-baa#NPRPAC>.

Compliance with the above requirements includes the mandate for proposers to implement the security requirements specified by National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171, “Protecting Controlled Unclassified Information in Nonfederal Information Systems and Organizations” (see <https://doi.org/10.6028/NIST.SP.800-171r1>) that are in effect at the time the BAA is issued.

For awards where the work is considered fundamental research, the contractor will not have to implement the aforementioned requirements and safeguards. However, should the nature of the work change during performance of the award, work not considered fundamental research will be subject to these requirements.

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.

- **Technical POC:** Joseph Altepeter, Program Manager, DARPA/DSO
- **BAA Email:** InvisibleHeadlights@darpa.mil
- **BAA Mailing Address:**
DARPA/DSO
ATTN: HR001120S0045
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 InvisibleHeadlights@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 BAA expiration date as stated in Part I.

B. Proposers Day

The Program Proposers Day was held on March 16, 2020 via webcast. Materials related to the Proposers Day, including all Government presentations, can be downloaded from the DARPA Opportunities web site.