

**Scalable, Adaptive, and Resilient Autonomy
(SARA)
Funding Announcement Opportunity**

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FUNDING OPPORTUNITY OVERVIEW

1. Federal Awarding Agency Name

Combat Capabilities Development Command (CCDC)

U.S. Army Research Laboratory
2800 Powder Mill Road
Adelphi, MD 20783-1197

Issuing Acquisition Office

U.S. Army Contracting Command – Aberdeen Proving Ground, Research Triangle Park (RTP)
Division

800 Park Office Drive
Suite #4229
Research Triangle Park, NC 27709

2. Research Opportunity Title

Scalable, Adaptive, and Resilient Autonomy (SARA)

3. Announcement Type

Funding Opportunity Announcement

4. Funding Opportunity Number

W911NF-20-S-0005 (The same FOA number from the first cycle will be used throughout all cycles of the program, but will be amended at the beginning of each cycle to reflect current topic area descriptions and other relevant program updates.)

5. Catalog of Federal Domestic Assistance (CFDA) Number(s)

12.630 - "Basic, Applied, and Advanced Research in Science and Engineering"

6. SARA Website: <https://www.arl.army.mil/sara/>

7. Key Dates:

The following is a summary of the events and dates associated with this Cycle under the overall SARA Funding Opportunity Announcement (FOA):

<u>EVENT</u>	<u>ESTIMATED DATE/TIMEFRAME</u>
Opportunity released	15 January 2019
Opportunity Webinar	24 January 2020
Deadline for Questions on Funding Opportunity	31 January 2020
Proposals due for Cycle 1	14 February 2020
Cycle 1 Awards	April 2020 (Expected)

Scalable, Adaptive, and Resilient Autonomy (SARA)

A. PROGRAM DESCRIPTION

1. Background

Purpose: Future Army forces will need to conduct cross-domain maneuver (CDM) and at times, operate semi-independently, disbursed, and while communications and infrastructure such as Global Positioning System (GPS) are disrupted or denied. Robotics and Autonomous Systems (RAS) will play a key role in expanding the operational reach, situational awareness, and effectiveness of maneuver forces in CDM. The Combat Capabilities Development Command (CCDC) Army Research Laboratory (ARL) is focused on developing fundamental understanding and informing the art-of-the-possible for warfighter concepts through research to greatly improve air and ground based autonomous vehicle perception, learning, reasoning, communication, navigation, and physical capabilities to augment and increase the freedom of maneuver in complex and contested environments. The Scalable, Adaptive, and Resilient Autonomy (SARA) program is focused on developing and experimentally accelerating emerging research in autonomous mobility and maneuverability, scalable heterogeneous and collaborative behaviors, and human agent teaming to realize adaptive and resilient Intelligent Systems that can reason about the environment, work in distributed and collaborative heterogeneous teams, and make op-tempo decisions to enable Autonomous Maneuver in complex and contested environments. In order to achieve this vision, advancements are needed in following:

- Novel methods for all-terrain ground and aerial maneuver to interact with and move through complex environments.
- Methods for scalable and heterogeneous collaborative behaviors in support of collaborative air and ground manned-unmanned teaming operations.
- Techniques for improved perception, decision-making, and adaptive behaviors for fully autonomous maneuver in contested environments.
- Methods, metrics, and tools to facilitate, simulate, and enable testing and evaluation of emerging approaches for intelligent and autonomous systems under Army relevant constraints and environments
- Experimental testbeds to develop and refine knowledge products to inform and transition technology to Army stakeholders.

The SARA program will consist of a series of technology sprint topics executed in annual program cycles. Each topic will be focused on addressing a different scientific area within the scope of the broad research aims of SARA. Each topic will be carefully chosen based on both program achievements from the previous year, on scientific and technological advancements by the broader research community, and in a way to systematically converge on the specific long-term SARA program goals.

SARA has been developed in coordination with other related ARL-funded collaborative efforts

(see descriptions of ARL collaborative alliances at <https://www.arl.army.mil/www/default.cfm?page=93>) and shares a common vision of highly collaborative academia-industry-government partnerships; however, it will be executed with a program model different than previous ARL Collaborative Research/Technology Alliances. Specific components of the program are highlighted below:

- SARA sprint topics will be executed through a series of annual program cycles. The FOA will be amended annually to identify a specific problem statement, or topic, for that specific Cycle. The topic for each Cycle will be chosen to systematically converge on the specific long-term program goal.
- Nine new topics (Cycles 1-9) are expected from FY20-FY29, with each topic focused on addressing a different scientific area within the scope of the broad research aims of SARA. Each topic will be carefully chosen based on both program achievements from the previous year, on scientific and technological advancements by the broader research community, and in a way to systematically converge on the specific long-term SARA program goals.
- For each topic, funding will be provided to those Recipients selected under a cooperative agreement (CA) described as the “seedling” project.
- The Recipients of a “seedling” CA are then eligible for consideration to receive funding for a single optional extension of up to 3 years at the conclusion of the “seedling” project.
- There is no limitation on the place of performance although on-site collaboration at ARL facilities and with ARL researchers as well as with other seedling Recipients is encouraged. It is mandatory that all Recipients participate at bi-annual experimentation events. For SARA cycle #1, the events are planned to take place at Camp Lejeune, NC. The first event will be a coordination event for all seedling Recipients in April of 2020. Seedling awardees will be required to attend a 3 day period during this two week event conducted by ARL to witness testbeds, ARL baseline experimentation, and the ARL autonomy stack in operation. A full two-week experimentation event for all seedling Recipients and ARL collaborative researchers to experimentally evaluate integrated solutions from the seedling Recipients on ARL testbeds and within the ARL software autonomy stack will be held in October of 2020 at Camp Lejeune or an equivalent test site. Future SARA cycles will rotate to different sites depending on the nature of the sprint topic.

Proposals that are in compliance with the requirements of the FOA will be evaluated in accordance with merit-based, competitive procedures. These procedures will include evaluation factors and an adjectival and color rating system. A review team, consisting of a qualified group of scientists and managers will evaluate the compliant proposals and provide the results of that evaluation to the decision-maker for the Government.

Eligible applicants under this FOA include institutions of higher education, nonprofit organizations, and for-profit organizations (i.e., large and small businesses) for scientific research in the knowledge domains outlined throughout this Funding Opportunity. Federally Funded Research and Development Centers (FFRDC) may propose as well, with effort as allowed by their sponsoring agency and in accordance with their sponsoring agency policy.

Cycle 1 Technology Sprint Topic: Off-Road Autonomous Maneuver. We have focused this announcement (Cycle 1) on “Off-Road Autonomous Maneuver.” Within “Off-Road Autonomous Maneuver,” there are three sub-topic areas of interest as described below.

Sub-topic #1: Off-road autonomous “GROUND” maneuver: Army RAS will need to operate in environments much more complex, unstructured, and with less infrastructure than what is currently being developed for commercial applications such as driverless cars. Future Army autonomous ground systems such as the Robotic Combat Vehicle will need to traverse complex off-road environments with limited previous knowledge of the environment, human interventions, or external supporting infrastructure. In order to demonstrate the necessary robustness to unknowns and resiliency in complex environments, significant advancements in algorithms for autonomous navigation in perception, learning, reasoning, decision making, and adaptive planning will be required. Sprint sub-topic area #1 is focused on how to increase the operational tempo and mobility of autonomous ground systems to traverse increasingly complex off-road environments.

Assumptions for Sprint sub-topic area #1:

- Single Platform, GPS limited/denied navigation
- Unprepared Terrain – Forest environment
- Point A to B navigation over distances on the order of kilometers with potential for area/zone search at point B
- Ability to operate with and without a stale map a priori
- Not reliant on communication/data feeds to complete a commanded task
- Development can be done on performer platforms, but the bi-annual experimentation events will be done on ARL provided platforms and with solutions integrated into the ARL autonomy architecture and autonomy software stack as defined below.

Topics of interest for Sprint sub-topic area #1 include but are not limited to:

- Integrated AI/Reasoning approaches focused on reasoning about objects in the environment for natural object detection and characterization and to solve navigation problems including negative and water hazards.
- Techniques for improved semantic perception, decision making, and adaptive behaviors for fully autonomous maneuver and terrain aware navigation through off-road environments.
- Ability to perceive and follow paths through forested environments.
- Ability to perceive and follow large scale, possibly unstructured, terrain features like tree lines.
- Development of a persistent world model and the ability of RAS to learn & adapt navigation planning and behaviors.
- Algorithms focused on reducing reasoning, planning, and processing time to increase operational speed in moderate off-road conditions (off road trails, field transverse, sparse forest with limited underbrush, etc).
- Algorithms and methods to increase understanding, terrain modeling, and path planning for slow-speed complex terrain traversability assessment and 2.5 D Planning through complex terrain (complex terrain with positive and negative obstacles such as rock fields, ditches, fords, heavily forested areas with underbrush, etc).
- Algorithms for increased resiliency in terrain aware navigation to include robustness to wide variations in environmental conditions.
- Algorithms that can detect, reason about, and plan in the presence of dynamic objects.

- Methods for increased state awareness and reduced uncertainty in navigation planning for off-road maneuver.
- Methods, metrics, and tools to facilitate, simulate, and enable testing and evaluation of emerging approaches for intelligent and autonomous systems under Army relevant constraints and environments resulting in verifiable autonomous behaviors.

Metrics:

Recipients will be expected to integrate their solutions onto ARL testbeds and into ARL's autonomy stack for the experimental events. At these experimental events, Recipients, using the ARL testbeds and autonomy stack, will conduct autonomous maneuvers per the assumptions above and their performance will be evaluated against the baseline ARL platform and autonomy stack performance (as measured during the first **Bi-Annual Experimentation Event**) and criteria such as: _

- Number and duration of Human interactions needed to complete task.
- Mean Distance Between Interactions.
- Mean Time Between Interactions.
- Speed to complete navigation task compared to a manned system, a single tele-operated ground RAS, and the baseline ARL autonomy stack at the start of the sprint.
- Complexity of terrain traversed based on number, density, and type of obstacles.

Sub-topic #2: Autonomous “AERIAL” maneuver through off-road environments: Future ground autonomous vehicles will not operate in isolation, they will be teamed with other ground robotics, small and large unmanned aerial systems, and with dismounted and mounted Soldiers. Sub-topic area #2 begins to explore how to increase the operational tempo and mobility of aerial autonomous systems to navigate increasingly complex off-road environments such as forest roads, along field edges, and above, through, and under canopy forested environments in order to support ground platforms and dismounted Soldiers. Addressing this sub-topic area will require significant advancements in algorithms for autonomous navigation in perception, learning, reasoning, decision making, and adaptive planning to succeed. UAS may carry a diversity of computers, sensors, radios, and other payloads. Hardware designs may implement possibly well-known methods but particular consideration must be given to the low size, weight, and power requirements concomitant with small unmanned aerial systems. Sprint sub-topic area #2 is focused on how to increase the operational tempo and mobility of autonomous aerial systems to traverse increasingly complex off-road forested environments.

Assumptions for Sprint sub-topic area #2:

- Single Platform, GPS-intermittent/denied navigation
- Unprepared Terrain – Forest environment
- Point A to B navigation over distances on the order of kilometers with potential for area/zone search at point B
- Ability to operate with and without a stale map a priori
- Not reliant on communication/data feeds to complete a commanded task
- Development can be done on performer platforms, but the bi-annual experimentation events will be done on ARL provided platforms and with solutions integrated into the ARL aerial autonomy architecture and autonomy software stack as defined below.

Topics of Interest for Sprint sub-topic area #2 include but are not limited to:

- Parsimonious methods to perceive obstacles at a sufficiently large range to adjust speed and course accordingly, including particular consideration for EO/IR fused monocular vision as a modality and thin obstacles such as wires, vines, and branches.
- Ability for perception and navigation methods to operate in a wide range of lighting conditions, to include night operation.
- Methods for incorporation of GPS-intermittent/denied operation in forested environments, leveraging vision and/or other signals of opportunity, to include required considerations for robustness and resilience needed for closing the loop onboard a UAV in a variety of environments.
- Ability to incorporate and fuse vision-based odometry algorithms intended for low altitudes (< 20 m) with alternative methods intended for moderate altitudes (20-400 m) based on absolute positioning leveraging onboard maps/databases.
- Usage of on-board radar fused with inertial sensing for odometric estimation and fusion of on-board radar with EO/IR sensing for small target and obstacle detection or visual/inertial/radar odometry.
- Ability to perceive and follow large scale, unstructured, terrain features (e.g. paths through forests, tree lines).
- Architectures to support dynamic re-allocation of computing resources between subroutines, running within the Robot Operating System (ROS), based on changing task/mission context and on-demand information requests.
- Algorithms that can detect, reason about, and plan in the presence of dynamic objects, including the ability to track, geo-localize, and maneuver relative to objects.
- Methods for incorporation of dynamic/real-time and onboard learning supporting object detection and maneuver behaviors.

Metrics:

Recipients will be expected to integrate their solutions onto ARL testbeds and into ARL's autonomy stack for the experimental events. At these experimental events, Recipients, using the ARL testbeds and autonomy stack, will conduct autonomous maneuvers per the assumptions above and their performance will be evaluated against the baseline ARL platform and autonomy stack performance (as measured during the first **Bi-Annual Experimentation Event**) and criteria such as:

- Number and duration of Human interactions needed to complete task.
- Mean Distance Between Interactions.
- Mean Time Between Interactions.
- Speed to complete navigation task compared to a manned system, a single tele-operated UAS, and the baseline ARL autonomy stack at the start of the sprint.
- Complexity of environment traversed based on number, density, and type of obstacles.
- Flight distance, speed, number of maneuvers, or mean time between failure (MTBF) (missions per crash) for UAS platforms.

Sub-topic #3: Large scale heterogeneous autonomous systems experimentation: Software infrastructure to orchestrate and manage large-scale air-ground collaborative experiments. Even single agent experiments increasingly employ highly complex software systems requiring management of execution, runtime monitoring, configuration, and version-control and validation of emergency stop functionality and other safety measures. Replicating these complexities across large-scale multi-agent experiments, including concerns such as vehicle deployment and battery management, only compounds the challenge and deters reproducible experiments.

Assumptions for Sprint sub-focus area #3:

- Up to one priority ground platform, one non-priority ground platform, and two air platforms will need to be controlled and coordinated.
- Systems will need to operate over unprepared forest environments at distances of kilometers and urban environments over 100s of meters.

Topics of Interest for Sprint sub-topic area #3 include but are not limited to:

- Software to support multi-agent field experimentation to include management of execution, runtime monitoring, configuration, and version-control and validation of emergency stop functionality and other safety measures.
- Software and experiment infrastructures that support these challenges and provide real-time experiment monitoring are of interest.

Bi-Annual Experimentation Events and ARL Testbeds: There is no limitation on the place of performance although on-site collaboration at ARL facilities and with ARL researchers as well as with other Seedling Recipients is encouraged. It is mandatory that all Recipients participate at bi-annual experimentation events. For SARA cycle #1, the events are planned to take place at Camp Lejeune, NC. The first event will be a coordination event for all Seedling Recipients in April of 2020. Seedling awardees will be required to attend a 3 day period during this two week event conducted by ARL to witness testbeds, ARL baseline experimentation, and the ARL autonomy stack in operation. A full two-week experimentation event for all Seedling Recipients and ARL collaborative researchers to experimentally evaluate integrated solutions from the Seedling Recipients on ARL testbeds and within the ARL software autonomy stack will be held in October of 2020 at Camp Lejeune or an equivalent test site. Future SARA cycles will rotate to different sites depending on the nature of the sprint topic.

These Experimentation Events will be two week events at which seedling Recipients will be required to experimentally demonstrate and evaluate their algorithms and hardware solutions on ARL RAS testbeds and in the ARL Autonomy Architecture as described below. There will be monthly mandatory coordination video teleconference meetings leading up to the bi-annual events to update on progress towards integration of hardware and software solutions in both simulation and on actual testbeds prior to the bi-annual events. As noted below, the baseline ARL Autonomy architecture and software stack will be made available to seedling Recipients as GFE at award of the CA for development purposes. Awards will contain terms and conditions for receipt of this GFE. Proposals should describe a plan and ability to integrate hardware and algorithm solutions onto planned ARL testbeds, ARL Autonomy Architecture, and the ARL Autonomy Software Stack as provided below:

ARL Testbed(s): Development can be done on performer platforms, but the bi-annual experimentation events will be done on ARL provided platforms and with solutions integrated into the ARL autonomy architecture and autonomy software stack as defined below.

Ground testbeds include both a small and large platform, the Clearpath Robotics Husky and Warthog respectively. The Husky is approximately 1 m³ with a maximum speed of 1.0 m/s while the Warthog is approximately 2 m³ with a maximum speed of 5 m/s. Both platforms are equipped with the following baseline compute and sensor payload:

- Two (2) Intel i7 computers with 16GB RAM, 1TB of SSD storage, and NVIDIA GTX 1660 GPU

- LIDAR: Ouster OS-1 Lidar (64-beam)
- IMU: Microstrain 3DM-GX5-25
- RGBD Camera: Intel Realsense D435i
- High Resolution Camera: AVT Manta G-507C Gigabit Ethernet
- Hardware Time Synchronization: Masterclock GMR1000 providing PTP server to LIDAR and cameras, PPS signal to IMU

Air Vehicle Testbed:

- Small Quadrotor
 - 250-700 g vehicle
 - 3-5” prop size
 - 5-20 min flight time
 - PX4-based autopilot with GPS and RC receiver
 - Ventral optical flow and laser altimeter
 - NVIDIA TX2 processor board
 - Onboard EO (1280x1024) and IR(640x480) global and rolling shutter cameras
 - Optional radar (assume 30 deg azimuthal and elevation field of regard and 70m detection range)
- Large Quadrotor
 - 700 g – 5 kg vehicle
 - 5-10” prop size
 - 10-20 min flight time
 - 15-35 W embedded computer such as:
 - Intel NUC
 - Nvidia Jetson TX2 or Xavier
 - Onboard cameras for VIO and object detection such as intel realsense T265 and D435i, Flir Boson, and machine vision imagers (e.g. IDS ueye).
 - Optional planar LIDAR
 - Optional high resolution IMU such as Vectornav v100
 - Pixhawk derivative flight controller
 - RC receiver
 - Downward facing distance sensor such as a ToF or Lidar based sensor
 - GPS

Autonomous systems need to be open access to support S&T development of single agent autonomy, be integrated into multi-agent autonomy schemes, and be developed to conform to DoD data and network security protocols. Research proposals should consider and address impact of Senate Bill (S.1790) - National Defense Authorization Act for Fiscal Year 2020 SEC. 848. “PROHIBITION ON OPERATION OR PROCUREMENT OF FOREIGN-MADE UNMANNED AIRCRAFT SYSTEMS” will have on proposed research. A high degree of system integration cost is associated with the successful co-development of hardware/software solutions for well-integrated systems which are sourced domestically (or from allied nations) or become Government owned. Proposals that include innovation in open architecture hardware design / selection and algorithm implementation leading to significant decreases in size, weight, power and cost will be a priority. Solutions with restrictive Intellectual Property or non-open architecture solutions will also be considered, but must show a pathway to transition to future Army systems and integration and operation within the ARL autonomy software stack.

ARL Autonomy Architecture:

The autonomy architecture is based on packages and components implemented with the Robotic Operating System (ROS) to enable reproducibility and modularity. Reproducibility derives from package meta-data (ROS package.xml) and build system (catkin-tools). We consider modularity at two scales: both individual algorithms/nodes and clusters of nodes that provide capability. The architecture depends on the TF library and adheres to the ROS Enhancement Protocol. Central to the world model and representations of the architecture is the adoption of pose-graph-based solutions to the simultaneous localization and mapping (SLAM) problem for GPS-denied or degraded localization. That is, representations of the world consume a list of frame correction (e.g., map to odometry) in order to process observations in a consistent frame (e.g., map). Finally, we assume a federated world model - the location and communication of data is in the hands of the system designer.

Contributions to the existing architecture come in three possible ways:

1. Replace an existing algorithm (i.e., node) with one that maintains the same input/output specifications. Experiments should then be conducted to show improved performance.
2. Add an existing algorithm or capability to the existing system. Experiments should then be conducted to show augmented capability.
3. Replace an existing capability (i.e., cluster of nodes) such that aggregate input/output specifications are maintained. Experiments should then be conducted to show maintained end-to-end performance and augmented capabilities.

ARL Ground Autonomy Software Stack:

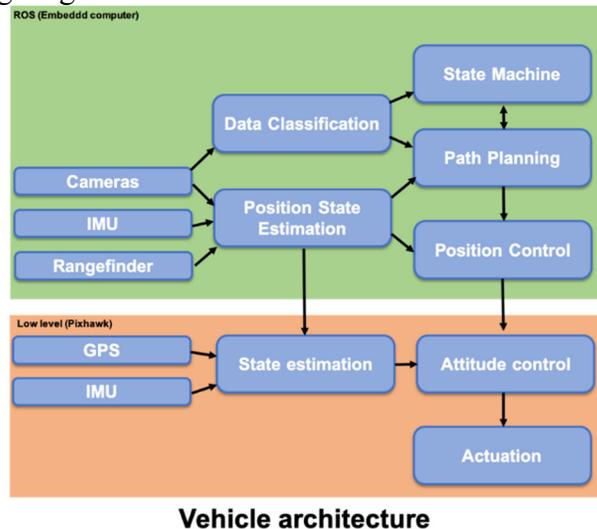
The existing ARL autonomy software stack provides an implementation of the architecture described above and will be provided as GFE to seedling recipient. It consists of four major capabilities:

1. Perception pipeline: Take sensor data, e.g., RGB images and point clouds, and process to symbolic observations. Components include object detection, per-pixel image classification, object position/pose estimation based on LIDAR, etc.
2. Simultaneous Localization and Mapping (SLAM): Using sensor data and perception pipeline products, formulate SLAM problem as a pose-graph optimization and solve. Includes components for point cloud alignment (ICP), pose-graph optimization (GTSAM), caching/data-association/fusion of symbolic object measurements, renderers of terrain classes/occupancy grids/point clouds.
3. Metric Planning and Execution: Use metric model of the world to achieve metric goals, e.g., waypoint navigation. Includes components for global planning (e.g., lattice-based motion planning), local planning (e.g., trajectory optimization), and an executor to sequence planning and control.
4. Symbolic Planning: Use symbolic model of the world to achieve symbolic goals, e.g., going near a particular object. Underlying symbolic planning architecture is based on behavior trees. Includes components for mission planning (e.g., the Planning and Acting using Behavior Trees), mission execution, sample behaviors that interface with mission planning/execution and the metric planning/execution layer (e.g., going to an object).

Flight Software Stack:

ARL quadrotors are able to navigate without GPS and avoid obstacles, as well as perceive their environment and recognize objects of interest. The flight control functionality is organized as

shown in the following diagram:



The ARL flight software is ROS and PX4 based, and is source controlled using GIT. The repository itself is a catkin workspace, with multiple public and private ROS modules forming most of the functionality. It also contains docker and catkin profiles for aid in building the software on embedded targets. The goal for the repository is that the same software can be built installed either on a desktop for software in the loop simulations or on the appropriate embedded target.

Organization and notable packages:

- communication – Macros for communication with PX4 flight controller
- control – path planning and position control
- descriptions – URDF files that describe the air vehicles
- drivers – PX4, realsense, snapdragon flight drivers
- executives – Python based state machine for high level control
- launch files – system wide files for running software
- perception – fiducial marker recognition and image classifiers
- simulation – Gazebo and Unity based simulation tools

ARL Simulation Testbed(s):

ARL's simulation environment utilizes the Unity game engine using a custom interface to pass data between ROS and the simulation engine. This simulator works as a "software in the loop (SITL)" in that it simulates sensors and actuators, with the autonomy software stack interfacing in the same way as it would on a physical robot. It utilizes a rigid body physics simulation for basic dynamics and collision modeling.

Implemented sensors include cameras, Lidars, IMUs and wheel encoders. Actuators include wheels and motors. Robots that have been tested are a Clearpath Husky and a generic quadrotor. Several environments exist, including an urban, swamp and MOUT site that mimics a small, urban village. Environments can be built and modified using the Unity Editor, which allows for modifying and creating in game assets will be available to seedling recipients for developmental purposes.

Proposal Intent: It is the intent of this FOA to solicit the most creative, innovative, and flexible

approaches to the ultimate goal of generating and exploiting research to solve pressing research gaps and issues impacting both the military and commercial sectors. This FOA seeks Proposals which will result in the award of multiple CAs. Proposals will be solicited for innovative solutions that will advance the state-of-art and the provided baseline ARL autonomy capability along the sprint topic focus area(s) and that will result in experiments demonstrating the art-of-the-possible to inform future warfighter concepts, and augment the Army RAS code and technology base. Compliant proposals will be evaluated, as discussed below, with a down select award decision.

- For each cycle, funding will be provided to selected Recipients under a cooperative agreement (CA). For the first cycle the period of performance will be nine months. These 1st year CA awards are described as the “seedling” project.
- Total number of seedling Recipients and funding per Recipient will vary from year to year at the discretion of the Government and based on available funding. ARL reserves the right to negotiate with an Applicant to re-scope their proposal technical focus, period of performance, and associated costs in order to maximize the available program funding, balance of research topics across the program, and overall impact to the program.
- The Recipients of a “seedling” CA are then eligible for consideration of a single optional extension of up to 3 years at the conclusion of the “seedling” project.
- A decision to exercise an option will be made based on a review of the seedling technical and fiscal performance, potential of the proposed optional effort to significantly improve the state-of-the-art beyond the results of the seedling effort, the relevancy of the technology to the overall SARA program and Army maneuver goals, the ability of the effort to substantially contribute to the ARL autonomy testbed and code base for informing and transitioning to other Army and DoD programs, and the availability of funding and balance of research topics across the program. ARL also reserves the right to negotiate with an Applicant to re-scope their optional proposal technical focus, period of performance, and associated costs in order to maximize the available program funding, balance of research topics across the program, and overall impact to the program.
- Proposals can address one or more of the sub-topics within this special notice.
- Proposals should address one or more, but need not address all, of the areas of interest identified within each sub-topic within this special notice.
- The success of this multidisciplinary effort will require meaningful collaborative partnerships between government, academia, and industry to advance the science. Proposals should address their intellectual property (IP) approach and how their approach will foster collaboration with ARL and other SARA Recipients, and how their solution will further advance the state-of-art of open source or ARL/government owned autonomy solutions.
- Proposals should also include descriptions for optional extensions of their proposed seedling effort for consideration in the optional period of performance.
- The research proposed and performed must comply with the definition for Budget Activities 1-3 research as outlined in the DoD Financial Management Regulation (FMR), Volume 2B, Chapter 5. Budget Activity 1 is for basic research. Budget Activity 2 is for applied research.

Budget Activity 3 is for advanced technology development. See DoD 7000.14-R for additional details.

- All funding is expected to be expended within the cycle period of performance. Available funding will vary from cycle to cycle, for cycle #1 a total of \$3M is expected. Multiple awards are expected to be funded out of the Cycle #1 total amount of \$3M. Proposals are expected to be bid at a cost commensurate with the level of effort. Awards will be made based on the impact to advancing the state-of-the-art. While sub-topic #1 is a priority, sub-topics 2-3 are of high interest and ARL reserves the right to adjust the balance of research across the three sub-topics based on merit of proposals received and potential impact to the overall program and advancing the state-of-the-art. ARL also reserves the right to negotiate with an Applicant to re-scope their proposal and associated costs in order to maximize the available program funding.

Collaboration: SARA addresses a critical objective within a broader Army goal to advance the state-of-art in air and ground based autonomous vehicle perception, learning, reasoning, communication, navigation, and physical capabilities to augment and increase the freedom of maneuver in complex and contested environments. This program has been developed in coordination with other related ARL-funded collaborative efforts (see descriptions of ARL collaborative alliances at <https://www.arl.army.mil/www/default.cfm?page=93>) and shares a common vision of highly collaborative academia-industry-government partnerships. However, with the rapid pace of technology development SARA will implement a novel, synergistic approach/structure. Annual Cycles will be explicitly structured to foster the greatest degree of collaboration and knowledge sharing to optimally leverage or combine findings from each effort awarded under each cycle and directly tie with internal ARL research programs. This will happen through mandatory monthly collaboration and coordination video teleconferences and the two week collaborative Bi-Annual Experimentation events. This structure is intended to more effectively and efficiently achieve the overall goals of the SARA program by preventing unnecessary duplication or silos of information, findings, technology or other relevant outcomes from ARL investment (internal and external). In other words, the success of SARA requires a multidisciplinary, collaborative effort that *synergistically views every new funded effort as a network of research or “building block” to grow and support an ecosystem of high-quality, innovative researchers actively sharing knowledge and collaboratively addressing scientific gaps critical to the Department of Defense.* Given this novel approach, Government researchers and program managers will be taking a more active role to support rapid integration of findings and cohesion within the research ecosystem. Research results of each Awardee and that of ARL staff under the SARA program are expected to build on in a coordinated, collaborative, and cumulative manner to significantly advance the state-of-art and in SARA technologies. To support this collaborative and cumulative engagement and environment, software code developed under the SARA program will be added to the ARL Autonomy Stack Repository for use by current and future ARL and sprint performers. Performers will be given access to a private Gitlab project so that SARA technologies can be integrated into the baseline ARL Autonomy Stack through a feature-branch methodology including pull requests, code review, and automated testing.

B. FEDERAL AWARD INFORMATION

Multiple CAs may be awarded from this FOA. The Applicants selected for award will be notified by the Grants Officer or his/her designee telephonically or via email. The CA award is not official until the Recipient has received the award signed by the Grants Officer.

CAs for Institutions of Higher Education and nonprofit organizations are primarily governed by the following:

- Federal statutes
- Federal regulations
- 2 CFR Part 200, as modified and supplemented by DoD's interim implementation found at 2 CFR Part 1103

CAs for For-Profit Recipients are primarily governed by the following:

- Federal statutes
- Federal regulations
- 32 CFR Part 34

The following websites may be accessed to obtain an electronic copy of the governing regulations and guidance:

- FAR, DFARS, and AFARS: https://www.acquisition.gov/content/regulations_Code of Federal Regulations: <http://www.ecfr.gov>
- DoD Research and Development General Terms and Conditions JULY 2018
- ACC-APG-RTP Division Assistance, Research General Terms and Conditions dated AUGUST 2016

Anticipated Core Funding Cycles:

	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	Proposal Submissions
Cycle 1	B	O	O	O								Feb 2020
Cycle 2		B	O	O	O							Oct 2021
Cycle 3			B	O	O	O						Oct 2022
Cycle 4				B	O	O	O					Oct 2022
Cycle 5					B	O	O	O				Oct 2023
Cycle 6						B	O	O	O			Oct 2024
Cycle 7							B	O	O	O		Oct 2025
Cycle 8								B	O	O	O	Oct 2026

Note: B is for Base (“seedling”) period of Cooperative Agreement; O indicates 3-yr Option.

All funding is expected to be expended within the cycle period of performance. Available funding will vary from cycle to cycle, for cycle #1 a total of \$3M is expected. Multiple awards are expected to be funded out of the Cycle #1 total amount of \$3M. Proposals are expected to be bid at a cost commensurate with the level of effort.

Award Instrument: This Funding Opportunity is expected to result in the award of multiple “seedling” cooperative agreements (CA) during each Cycle as defined at 31 U.S.C. 6305 for the execution of the program. The CA is used to enter into a relationship:

- The principal purpose of which is to transfer a thing of value to the Recipient to carry out a public purpose of support or stimulation authorized by a law or the United States, rather than to acquire property or services for the Federal Government’s direct benefit or use.

- b. Substantial involvement is expected between the Federal Government and the Recipient when carrying out the activity contemplated by the CA.
- c. No fee or profit is allowed

Structure of Award: For Cycle #1, the CAs will consist of an initial 9-month Base award that will be executed and considered a “seedling” CA. The Recipients of a “seedling” CA are then eligible for consideration to receive funding for a single optional extension of up to 3 years at the conclusion of the “seedling” project. The period of the performance and funding amount of potential option periods will be based on the goals of the SARA program, merits of the proposed optional research and potential impact to advancing the SARA goals, and available funding.

Proposal Submission: The application process consists of proposal submissions from applicants for each Cycle under this FOA. Applicants should note there are page limitations and other requirements associated with the submission process. Submissions in connection with this FOA are due by the date and time specified below. FOA amendments for future topics will include the submission requirements for those submissions. The Government’s decision to award a seedling CA will be based upon the evaluation results of the proposal submission.

Period of Performance: The CA Awards made as a result of this FOA will provide for a period of performance of 9 months, with the potential to exercise an option period for up to three additional years at the discretion of the Government. ARL reserves the right to negotiate with an Applicant to re-scope their proposal or optional proposal technical focus, period of performance, and associated costs in order to maximize the available program funding, balance of research topics across the program, and overall impact to the program.

Place of Performance:

There is no limitation on the place of performance although on-site collaboration at ARL facilities and with ARL researchers as well as with other Seedling Recipients is encouraged. It is mandatory that all Recipients participate at bi-annual experimentation events. For SARA cycle #1, the events are planned to take place at Camp Lejeune, NC. The first event will be a coordination event for all Seedling Recipients in April of 2020. Seedling awardees will be required to attend a 3 day period during this two week event conducted by ARL to witness testbeds, ARL baseline experimentation, and the ARL autonomy stack in operation. A full two-week experimentation event for all Seedling Recipients and ARL collaborative researchers to experimentally evaluate integrated solutions from the Seedling Recipients on ARL testbeds and within the ARL software autonomy stack will be held in October of 2020 at Camp Lejeune or an equivalent test site. Future SARA cycles will rotate to different sites depending on the nature of the sprint topic.

Funding: This FOA is issued subject to the availability of funds. ARL has submitted the requisite documents to request funding for the period covered by the program. However, Applicants are reminded this request is subject to Presidential, Congressional and Departmental approval. Funding levels specified in this FOA are estimated funding levels and are for proposal preparation purposes only; actual funding levels of the CAs will be updated annually as part of the federal appropriation process.

Profit/Fee: Profit/fee is not permitted under the CA.

Cost Sharing: Cost sharing is not required under this FOA.

Opportunity Webinar: ARL will host an opportunity webinar on (see Event timeline above). A link to the webinar will be posted on the SARA Program website at:

<https://www.arl.army.mil/sara/>

Contact Information. Outside of questions posed at the Opportunity Webinar, all questions or comments concerning this FOA shall be submitted to the Government through the SARA Program website at <https://www.arl.army.mil/sara/>. Comments or questions submitted should be concise and to the point. In addition, the relevant part and paragraph of the FOA to which a comment or question pertains must be referenced. Responses to non-proprietary questions received will be posted to the SARA Program website under the “General Information/Questions & Answers” section for the benefit of all interested parties. All clearly identified and marked proprietary questions submitted will be responded to via an individual email response, not posted to the SARA Program website. Applicants are encouraged to submit questions as early as possible. The deadline for submission of questions which will be answered under this FOA is listed in Event timeline above. Any answers provided to questions do not change the requirements of this FOA. Future amendments to this FOA, including new cycle topics, will be issued via an amended FOA posted in grants.gov.

C. ELIGIBILITY INFORMATION

1. Eligible Applicants

It is our goal for the program to include a diverse group of Applicants with varied long-term interests. Participants may be institutions of higher education, for-profit, or non-profit organizations. Federally Funded Research and Development Centers (FFRDC) may propose as well, with effort as allowed by their sponsoring agency and in accordance with their sponsoring agency policy. Proposals may consist of teams from any combination of organizations (*e.g.*, prime and subawardees), but this is not a requirement for award and award will only be made to a single entity. For each Cycle, only those Applicants awarded a seedling CA will be eligible for consideration of a 3-year option period for that Cycle. All eligible Applicants may submit an application for future topics under future cycles.

2. Cost Sharing or Matching

Cost sharing is not required under this Funding Opportunity.

D. APPLICATION AND SUBMISSION INFORMATION

The application process consists of a single Proposal stage. Applicants will receive feedback regarding their proposal **ONLY IF IT IS SELECTED FOR AWARD**, in order to improve the proposal and ensure alignment of the proposed research with Government goals. Applicants with **non-selected proposals will be notified of their non-selection, but will not receive feedback.**

1. Address to Request Application Package

This Funding Opportunity may be accessed from the following: Grants.gov (www.grants.gov). Amendments, if any, to this FOA will be posted to these websites when they occur. Interested parties are encouraged to periodically check these websites for updates and amendments.

2. Content and Format of Application Submission

The following information is for those wishing to respond to the FOA:

Grants.gov Application Submission and Receipt Procedures

This section provides the application submission and receipt instructions for DoD program applications. Please read the following instructions carefully and completely.

DoD is participating in the Grants.gov initiative to provide the grant community with a single site to find and apply for grant funding opportunities. For this funding opportunity, DoD requires applicants to submit their applications online through Grants.gov. This funding opportunity may be found on Grants.gov by going to the Grants.gov Search Grants screen and entering the funding opportunity number for this FOA, W911NF-20-S-0005, in the Funding Opportunity search box. You can also search for the CFDA Number 12.560.

How to Register to Apply through Grants.gov

1. *Instructions:* Read the instructions below about registering to apply for DoD funds. Applicants should read the registration instructions carefully and prepare the information requested before beginning the registration process. Reviewing and assembling the required information before beginning the registration process will alleviate last-minute searches for required information.

Organizations must have a Data Universal Numbering System (DUNS) Number, active System for Award Management (SAM) registration, and Grants.gov account to apply for grants. Creating a Grants.gov account can be completed online in minutes, but DUNS and SAM registrations may take several weeks. Therefore, an organization's registration should be done in sufficient time to ensure it does not impact the entity's ability to meet required application submission deadlines.

Complete organization instructions can be found on Grants.gov here:

<https://www.grants.gov/web/grants/applicants/organization-registration.html>

- a. *Obtain a DUNS Number:* All entities applying for funding, including renewal funding, must have a DUNS Number from Dun & Bradstreet (D&B). Applicants must enter the DUNS Number in the data entry field labeled "Organizational DUNS" on the Standard Form (SF)-424 form. For more detailed instructions for obtaining a DUNS Number, refer to: <https://www.grants.gov/web/grants/applicants/organization-registration/step-1-obtain->

[duns-number.html](#)

- b. *Register with SAM:* All organizations applying online through Grants.gov must register with the System for Award Management (SAM). Failure to register with SAM will prevent your organization from applying through Grants.gov. SAM registration must be renewed annually. For more detailed instructions for registering with SAM, refer to: <https://www.grants.gov/web/grants/applicants/organization-registration/step-2-register-with-sam.html>
 - c. *Create a Grants.gov Account:* The next step is to register an account with Grants.gov. Follow the on-screen instructions or refer to the detailed instructions here: <https://www.grants.gov/web/grants/applicants/registration.html>
 - d. *Add a Profile to a Grants.gov Account:* A profile in Grants.gov corresponds to a single applicant organization the user represents (i.e., an applicant) or an individual applicant. If you work for or consult with multiple organizations and have a profile for each, you may log in to one Grants.gov account to access all of your grant applications. To add an organizational profile to your Grants.gov account, enter the DUNS Number for the organization in the DUNS field while adding a profile. For more detailed instructions about creating a profile on Grants.gov, refer to: <https://www.grants.gov/web/grants/applicants/registration/add-profile.html>
 - e. *EBiz POC Authorized Profile Roles:* After you register with Grants.gov and create an Organization Applicant Profile, the organization applicant's request for Grants.gov roles and access is sent to the EBiz POC. The EBiz POC will then log in to Grants.gov and authorize the appropriate roles, which may include the Authorized Organization Representative (AOR) role, thereby giving you permission to complete and submit applications on behalf of the organization. You will be able to submit your application online any time after you have been assigned the AOR role. For more detailed instructions about creating a profile on Grants.gov, refer to: <https://www.grants.gov/web/grants/applicants/registration/authorize-roles.html>
 - f. *Track Role Status:* To track your role request, refer to: <https://www.grants.gov/web/grants/applicants/registration/track-role-status.html>
2. *Electronic Signature:* When applications are submitted through Grants.gov, the name of the organization applicant with the AOR role that submitted the application is inserted into the signature line of the application, serving as the electronic signature. The EBiz POC **must** authorize people who are able to make legally binding commitments on behalf of the organization as a user with the AOR role; **this step is often missed, and it is crucial for valid and timely submissions.**

How to Submit an Application to DoD via Grants.gov

Grants.gov applicants can apply online using Workspace. Workspace is a shared, online

environment where members of a grant team may simultaneously access and edit different webforms within an application. For each funding opportunity announcement (FOA), you can create individual instances of a workspace.

Below is an overview of applying on Grants.gov. For access to complete instructions on how to apply for opportunities, refer to:

<https://www.grants.gov/web/grants/applicants/workspace-overview.html>

- a. *Create a Workspace:* Creating a workspace allows you to complete it online and route it through your organization for review before submitting.
- b. *Complete a Workspace:* Add participants to the workspace to work on the application together, complete all the required forms online or by downloading PDF versions, and check for errors before submission. The Workspace progress bar will display the state of your application process as you apply. As you apply using Workspace, you may click the blue question mark icon near the upper-right corner of each page to access context-sensitive help.

- 1) *Adobe Reader:* If you decide not to apply by filling out webforms you can download individual PDF forms in Workspace. The individual PDF forms can be downloaded and saved to your local device storage, network drive(s), or external drives, then accessed through Adobe Reader.

NOTE: Visit the Adobe Software Compatibility page on Grants.gov to download the appropriate version of the software at: <https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html>

- 2) *Mandatory Fields in Forms:* In the forms, you will note fields marked with an asterisk and a different background color. These fields are mandatory fields that must be completed to successfully submit your application.
 - 3) *Complete SF-424 Fields First:* The forms are designed to fill in common required fields across other forms, such as the applicant name, address, and DUNS Number. Once it is completed, the information will transfer to the other forms.
- c. *Submit a Workspace:* An application may be submitted through workspace by clicking the Sign and Submit button on the Manage Workspace page, under the Forms tab. Grants.gov recommends submitting your application package **at least 24-48 hours prior to the close date** to provide you with time to correct any potential technical issues that may disrupt the application submission.
 - d. *Track a Workspace Submission:* After successfully submitting a workspace application, a Grants.gov Tracking Number (GRANTXXXXXXXX) is automatically assigned to the application. The number will be listed on the Confirmation page that is generated after submission. Using the tracking number, access the Track My Application page under the Applicants tab or the Details tab

in the submitted workspace.

For additional training resources, including video tutorials, refer to: <https://www.grants.gov/web/grants/applicants/applicant-training.html>

Applicant Support: Grants.gov provides applicants 24/7 support via the toll-free number 1-800- 518-4726 and email at support@grants.gov. For questions related to the specific grant opportunity, contact the number listed in the application package of the grant you are applying for.

If you are experiencing difficulties with your submission, it is best to call the Grants.gov Support Center and get a ticket number. The Support Center ticket number will assist the DoD with tracking your issue and understanding background information on the issue.

Application forms and instructions will be available at Grants.gov. To access these materials, go to <http://www.grants.gov>, select "Apply for Grants", and then select "Download an Application Package." Enter the FOA number, W911NF-20-S-0005.

Applicants must complete the mandatory forms and any optional forms (e.g., SF-LLL Disclosure of Lobbying Activities) in accordance with the instructions on the forms and the additional instructions below. The required fields should be completed in accordance with the “pop-up” instructions on the forms. To activate the instructions, turn on the “Help Mode” (icon with the pointer and question mark at the top of the form). Files that are attached to the forms must be in Adobe Portable Document Form (PDF) unless otherwise specified in this announcement.

The following formatting rules apply for the file attachments:

- Paper size when printed – 8.5 x 11 inch paper
- Margins – 1 inch
- Spacing – Single
- Font – No Smaller than Times New Roman, 12 point

Form: SF 424 (R&R) (Mandatory) – Complete this form first to populate data in other forms. Authorized Organization Representative (AOR) usernames and passwords serve as “electronic signatures” when your organization submits applications through Grants.gov. By using the SF 424 (R&R), applicants are providing the certification required by 32 CFR Part 28 regarding lobbying.

Form: Research & Related Other Project Information - Complete questions 1 through 6 and attach files.

- **Project Summary/Abstract (Field 7 on the form)** - The Project Summary should be a brief summary of the content of the application. It shall include a title, the research team (include roles, expertise, affiliations), designation of Junior Investigator or Senior Investigator derivation, and a brief abstract articulating the project objectives. **The project summary/abstract must not exceed 1 page and will not be evaluated as it is primarily**

for documentation purposes.

- **Project Narrative (Field 8 on the form)** - Chapters and Numbers of pages – Field 7 is to contain the chapters set forth below and may not exceed the stipulated page counts for those chapters. Pages in excess of the page limits may be removed for the evaluation of the application. All chapters set forth below should be in a single PDF file. For those chapters with specified page limitations, any pages submitted beyond the specified amount for a chapter will not be reviewed or evaluation.
- Chapter 1: Technical Component. The pages included in Chapter 1 are to be numbered. Applicants are advised that Chapter 1 will not exceed 10 pages, utilizing one side of the page. Tables that extend beyond one page (fold out tables) will only count as one page.
 - Proposed Effort (approximately 4-5 pages): This section of Chapter 1 should include an overview of the research strategy to be employed to advance the state-of-the-art in enhancing performance in off-road autonomous maneuver; a short description and justification for annual research goals of the proposed effort; and a short technical discussion stating the background and objectives of the proposed research, and the overall technical approaches to be pursued. This technical discussion should include a proposed breakdown of research tasks and short description of the technical approaches for each task. The proposed effort should include the specific hypotheses to be tested, and what specific tasks will be performed by the research team to test them, as well as justification for why these are the appropriate measures.
 - Proposed Experimentation Event Participation and Collaboration Development (approximately 1-2 pages): Include here the plan for participation in the Experimentation Events in the spring and fall of 2020 in Camp Lejeune NC. Collaboration with US Army Research Lab or other Government research personnel and other Recipients at these events and over the course of the cycle will be required. Proposals should address any Intellectual Property and how their approach will foster collaboration with ARL and other Recipient's, and how their solution will further advance the state-of-art of open source or ARL/government owned autonomy solutions in the area of off-road maneuver.
 - Participant(s) roles, qualifications and bio-sketches (approximately 2 pages): Must include the names, primary role/availability, and brief biographies. Include plans for junior investigator development and mentorship of less experienced personnel (mentoring plan).
 - Proposed timeline (approximately 0.5-1 page): An estimated timeline of tasks to be completed during the 12-month period, including (1) components to be completed at the home institution(s) and (2) components planned during the Summer Summit
- Chapter 2: Optional Technical Component. The pages included in Chapter 2 are to be numbered. Applicants are advised that Chapter 2 will not exceed 4 pages, utilizing one side of the page. Tables that extend beyond one page (fold out tables) will only count as one page.

- Proposed Effort (approximately 2-4 pages): This section of Chapter 2 should include an overview of the research to extend the methods proposed in Chapter 1 if successful; a short description and justification for annual research goals of the proposed effort; and a short technical discussion stating the background and objectives of the proposed research, the overall technical approaches to be pursued. This technical discussion should include a proposed breakdown of research tasks and short description of the technical approaches for each task. The Proposed Effort should include the specific hypotheses to be tested, and what specific tasks will be performed by the research team to test them, as well as justification for why these are the appropriate measures.
- **Chapter 3: Cost Component.** The pages included in Chapter 3 will be numbered and Chapter 3 does not have a page limitation. Cost Application must include a budget for the period of performance. The cost portion of the application will contain cost estimates sufficiently detailed for meaningful evaluation, to include Summit series participation. Budget justification may also be attached in this chapter. Before award it must be established that an approved accounting system and financial management system exist. Proposals should include itemized budgets per the instructions below for both the base seedling effort as well as potential options periods and must be commensurate with the technical level of effort proposed.

For all applications, the budget details should include:

a. *Direct Labor*: Show the current and projected salary amounts in terms of man-hours, man- months, or annual salary to be charged by the personnel performing under this agreement either by personnel or position. State the number of man-hours used to calculate a man-month or man-year. For each person or position, provide the following information:

i. The basis for the direct labor hours or percentage of effort (e.g., historical hours or estimates);

ii. The basis for the direct labor rates or salaries. Labor costs should be predicted upon current labor rates or salaries. These rates may be adjusted upward for forecast salary or wage cost-of-living increases that will occur during the agreement period. The cost application should separately identify the rationale applied to base salary/wage for cost-of- living adjustments and merit increases. Each must be fully explained;

iii. The portion of time to be devoted to the requirements of the agreement;

iv. The total annual salary charged to the agreement; and

v. Any details that may affect the salary during the project, such as plans for leave and/or remuneration while on leave.

b. *Fringe Benefits and Indirect Costs (Overhead, G&A, and Other)*: The most

recent rates, dates of negotiation, the base(s) and periods to which the rates apply must be disclosed and a statement included identifying whether the proposed rates are provisional or fixed. If the rates have been negotiated by a Government agency, state when and by which agency. A copy of the negotiation memorandum should be provided. If negotiated forecast rates do not exist, applicants must provide sufficient detail to enable a determination to be made that the costs included in the forecast rate are allocable according to applicable cost provisions. Applicants' disclosure should be sufficient to permit a full understanding of the content of the rate(s) and how it was established. At a minimum, the submission should identify:

- i. All individual cost elements included in the forecast rate(s);
- ii. Basis used to prorate indirect expenses to cost pools, if any;
- iii. How the rate(s) was calculated;
- iv. Distribution basis of the developed rate(s);
- v. Basis on which the overhead rate is calculated, such as "salaries and wages" or "total costs;" and
- vi. The period of the applicant's FY.

c. Permanent Equipment: If facilities or equipment are required, a justification why this property should be purchased with Government funds must be submitted. State the organization's inability or unwillingness to furnish the facilities or equipment. Applicants must provide an itemized list of permanent equipment showing the cost for each item. Permanent equipment is any article or tangible nonexpendable property having a useful life of more than one year and an acquisition cost of \$5,000 or more per unit. The basis for the cost of each item of permanent equipment included in the budget must be disclosed, such as:

- i. Vendor Quote: Show name of vendor, number of quotes received and justification, if intended award is to other than lowest bidder.
- ii. Historical Cost: Identify vendor, date of purchase, and whether or not cost represents lowest bid. Include reason(s) for not soliciting current quotes.
- iii. Engineering Estimate: Include rationale for quote and reason for not soliciting current quotes.

If applicable, the following additional information shall be disclosed in the applicant's cost application:

- iv. Special test equipment to be fabricated by the Recipient for specific requirements in the agreement.

v. Standard equipment to be acquired and modified to meet specific requirements, including acquisition and modification costs, listed separately.

vi. Existing equipment to be modified to meet specific research requirements, including modification costs. Do not include equipment the organization will purchase with its funds if the equipment will be capitalized for Federal income tax purposes. Proposed permanent equipment purchases during the final year of an award shall be limited and fully justified.

vii. Grants and cooperative agreements may convey title to an eligible institution for permanent equipment purchased with project funds. At the discretion of the Contracting/Grants Officer, the agreement may provide for retention of the title by the Government or may impose conditions governing the equipment conveyed to the organization per the governing laws and regulations.

d. Travel: Forecasts of travel expenditures (domestic and foreign) that identify the destination (if known) and the various cost elements (airfare, mileage, per diem rates, etc.) must be submitted. The costs should be in sufficient detail to determine the reasonableness of such costs. Allowance for air travel normally will not exceed the cost of round-trip, economy air accommodations. Specify the type of travel and its relationship to the requirements of the agreement.

e. Participant Support Costs: This budget category refers to costs of transportation, per diem, stipends, and other related costs for participants or trainees (but not employees) in connection with DoD-sponsored conferences, meetings, symposia, training activities, and workshops. Generally, indirect costs are not allowed on participant support costs. The number of participants to be supported should be entered in the parentheses on the budget form. These costs should also be justified in the budget justification page(s) attached to the cost application.

f. Materials, Supplies, and Consumables: A general description and total estimated cost of expendable equipment and supplies are required. The basis for developing the cost estimate (vendor quotes, invoice prices, engineering estimate, purchase order history, etc.) must be included. If possible, provide a material list.

g. Publication, Documentation, and Dissemination: The budget may request funds for the costs of preparing, publishing, or otherwise making available to others the findings and products of the work conducted under an agreement, including costs of reports, reprints, page charges, or other journal costs (except costs for prior or early publication); necessary illustrations, cleanup, documentation, storage, and indexing of data and databases; and development, documentation, and debugging of software.

h. Consultant Costs: Applicants normally are expected to utilize the services of

their own staff to the maximum extent possible in managing and performing the project's effort. If the need for consultant services is anticipated, the nature of proposed consultant services should be justified and included in the technical application narrative. The cost application should include the names of consultant(s), primary organizational affiliation, each individual's expertise, daily compensation rate, number of days of expected service, and estimated travel and per diem costs.

i. Computer Services: The cost of computer services, including computer-based retrieval of scientific, technical, and educational information, may be requested. A justification/explanation based on the established computer service rates at the proposing organization should be included. The budget also may request costs, which must be shown to be reasonable, for leasing automatic data processing equipment. The purchase of computers or associated hardware and software should be requested as items of equipment.

j. Subawards (Subcontracts or Subgrants): A precise description of services or materials that are to be awarded by a subaward must be provided. For subawards totaling \$10,000 or more, provide the following specific information:

i. A clear description of the work to be performed;

ii. If known, the identification of the proposed subawardee and an explanation of why and how the subawardee was selected or will be selected;

iii. The identification of the type of award to be used (cost reimbursement, fixed price, etc.);

iv. Whether or not the award will be competitive and, if noncompetitive, rationale to justify the absence of competition; and

v. A detailed cost summary.

k. ODCs: Itemize and provide the basis for proposed costs for other anticipated direct costs such as communications, transportation, insurance, and rental of equipment other than computer related items. Unusual or expensive items must be fully explained and justified.

l. Profit/ Fee: Profit/fee is not allowed for the Recipient of or subaward to an assistance instrument, where the principal purpose of the activity to be carried out is to stimulate or support a public purpose (i.e., to provide assistance), rather than acquisition (i.e., to acquire goods and services for the direct benefit of the Government). A subaward is an award of financial assistance in the form of money, or property in lieu of money, made under a DoD grant or cooperative agreement by a Recipient to an eligible subrecipient. The term

includes financial assistance for substantive program performance by the Subrecipient of a portion of the program for which the DoD grant or cooperative agreement was made. It does not include the Recipient's procurement of goods and services needed to carry out the program.

- Bibliography and Reference Cited (Field 9 on the form)** – Attach a listing of applicable publications cited in above sections.
- Facilities and Other Resources (Field 10 on the form)** - The applicant is to provide a description of any facilities planned to be used for the project, whether at the home institution, a partner facility, or during the Innovation Summit Series. A note of support guaranteeing access to these facilities on behalf of their primary management should also be included. Attach this information at Field 10.
- Equipment (Field 11 on the form)** - The applicant is to include a listing of equipment available to support the application. Any Government equipment necessary for performance is to be clearly identified. Attach this information at Field 11.
- Other Attachments (Field 12 on the form)** are as follows:
 1. Attached the completed certifications.
 2. **FORM: SF-424 Research & Related Senior/Key Person Profile (Expanded) (Mandatory)** – The Degree Type and Degree Year fields on the Research and Related Senior/Key Person Profile (Expanded) form will be used by DoD as the source for career information. In addition to the required fields on the form, applicants must complete these two fields for all individuals that are identified as having the project role of PD/PI or Co- PD/PI on the form. Additional senior/key persons can be added by selecting the “Next Person” button
 3. **FORM: SF-424 (R&R) Personal Data (Mandatory)** - This form will be used by DoD as the source of demographic information, such as gender, race, ethnicity, and disability information for the Project Director/Principal Investigator and all other persons identified as Co-Project Director(s)/Co-Principal Investigator(s). Each application must include this form with the name fields of the Project Director/Principal Investigator and any Co-Project Director(s)/Co-Principal Investigator(s) completed; however, provision of the demographic information in the form is voluntary. If completing the form for multiple individuals, each Co-Project Director/Co-Principal Investigator can be added by selecting the “Next Person” button. The demographic information, if provided, will be used for statistical purposes only and will not be made available to merit reviewers. Applicants who do not wish to provide some or all of the information should check or select the “Do not wish to provide” option.
 4. **SF-LLL – Disclosure of Lobbying Activities.** If applicable, attach a complete SF-LLL at Field 11 of the R&R Other Project Information form. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee

of a Member of Congress in connection with the cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

5. Complete the **Representations under DoD Assistance Agreements: Appropriations Provisions on Tax Delinquency and Felony Convictions** (this can be found under National Policy Requirements)

3. Submission Dates and Times

Proposals are due in grants.gov by 3:00pm (local time in North Carolina, USA) on 14 February 2020. An email receipt will be provided to each Applicant for each Proposal submission received. Applications submitted after the closing date and time will not be considered or evaluated by the Government.

Application Receipt Notices

Grants.gov: After an application is submitted to Grants.gov, the AOR will receive a series of three emails from Grants.gov. The first two emails will be received within 24 to 48 hours after submission. The first email will confirm time of receipt of the application by the Grants.gov system and the second will indicate that the application has either been successfully validated by the system prior to transmission to the grantor agency or has been rejected due to errors. A third email will be received once the grantor agency has confirmed receipt of the application. Reference https://www.grants.gov/help/html/help/GetStarted/Get_Started.htm from the Grants.gov User Guide for information on how to track your application package.

For the purposes of this FOA, an applicant's application is not considered received by the Government until the AOR receives email #3.

E. APPLICATION REVIEW / EVALUATION INFORMATION

The following represents the evaluation criteria for this FOA:

Factor 1: Scientific Merit and Relevance: Evaluation of this factor will concentrate on the overall scientific and technical merit, creativity, innovation, and flexibility of the proposed research in light of the current state-of-the-art of SARA-relevant scientific topics, and the expected outcomes based on the timeline of execution. The scientific merit will be evaluated with regard to the specific research areas (e.g., a topic of interest within a sub-topic) to be addressed in this annual Funding Opportunity. Evaluation of this factor will also concentrate on the long-term relevance of the proposed research and the likelihood that the proposed research will address scientific challenges and research barriers facing the Army and commercial sectors.

Factor 2: Research Plan and Plan for Collaboration: Evaluation of this factor will concentrate on the Applicant's strategies, plans and experience in fostering collaborative research and managing collaborative research programs as set forth in this FOA. Evaluation of this factor will include evidence of previous successful collaborative efforts, plans for participation at the SARA Bi-annual Experimental Events, the Applicant's commitment and plans for collaboration within the program and the synergistic value of the collaborations among

researchers and government scientists, as well as approaches to data/coding/model sharing and transition of products that create collaborative potential amongst government, academic, and industry partners.

Factor 3: Experience and Qualifications of Scientific Staff and Junior Investigator Development: Evaluation of this factor will concentrate on the qualifications, capabilities, availability, proposed level of effort, and experience of both the Applicant's key research personnel (individually and as a whole), their relevant past accomplishments, and their ability to achieve the proposed technical objectives. Key personnel are expected to be substantially and meaningfully engaged in the research and the proposed level of effort for key personnel reflected in the proposal should be commensurate with and demonstrate such engagement. The extent to which the Applicant's proposed facilities and equipment will contribute to the accomplishment of the proposed research will be evaluated, including the nature, quality, relevance, availability, and access to state-of-the-art research facilities and equipment.

Factor 4: Cost. While this area will not be weighted, evaluation of this area will consider cost realism, cost reasonableness, and affordability within funding constraints. The Government may make adjustments to the cost of the total proposed effort as deemed necessary to reflect what the effort should cost. These adjustments will consider the task undertaken and approach proposed. These adjustments may include upward or downward adjustments to proposed labor hours, labor rates, quantity of materials, price of materials, overhead rates and G&A, etc.

Proposal Review and Selection Process

All timely and compliant Proposal submissions will be evaluated in accordance with the evaluation criteria set forth in this FOA. Proposals are expected to be evaluated by a group of qualified scientists and managers from the Government.

No other material outside of a Proposal will be provided to those evaluating proposals. An initial review of the proposals will be conducted to ensure compliance with the requirements of this FOA. Failure to comply with the requirements of the FOA may result in a proposal not being evaluated and receiving no further consideration for award.

Proposals that are timely and in compliance with the requirements of the FOA will be evaluated in accordance with merit based, competitive procedures. These procedures will include evaluation factors that will be evaluated using an adjectival and color rating system as follows:

OUTSTANDING (blue): The proposal is evaluated as outstanding for this factor. The proposal includes one or more significant strengths that are not offset by weaknesses.

GOOD (purple): The proposal is evaluated as good for this factor. The proposal includes some strengths that are not offset by weaknesses.

ACCEPTABLE (green): The proposal is evaluated as acceptable for this factor. Any strengths and weaknesses in the proposal balance out.

MARGINAL (yellow): The proposal is evaluated as marginal for this factor. While the proposal may or may not contain some strengths, and strengths are more than offset by any

weakness or weaknesses.

UNACCEPTABLE (red): The proposal is evaluated as unacceptable for this factor. While the proposal may or may not contain some strengths, and strengths are offset by any significant weakness or weaknesses.

A Review Team, consisting of a qualified group of scientists and managers, will evaluate the Proposals and provide the results of that evaluation to the decision maker for the Government. The decision maker will make decisions concerning award selection.

The Government will make award to the Applicant(s), whose proposal conforms to the Funding Opportunity that offers the most-favorably rated proposal(s) based on the evaluation criteria noted above. The Government reserves the right not to make an award should no acceptable Proposal be submitted. The Government also reserves the right to negotiate with an Applicant to re-scope their proposal or optional proposal technical focus, period of performance, and associated costs in order to maximize the available program funding, balance of research topics across the program, and overall impact to the program resulting in the development of an annual program plan to cover the optional research to be performed and the period of performance of that research.

Optional Period Review and Selection Process:

At the end of Cycle #1, the decision to exercise option periods of any seedling awards remains at the discretion of the Government. The Government also reserves the right to negotiate with an Applicant to re-scope their proposal or optional proposal technical focus, period of performance, and associated costs in order to maximize the available program funding, balance of research topics across the program, and overall impact to the program resulting in the development of an annual program plan to cover the optional research to be performed and the period of performance of that research.

Recipient Qualification

The Grants Officer is responsible for determining a Recipient's qualification prior to award. In general, a Grants Officer will award grants or CAs only to qualified Recipients that meet the standards at 32 CFR 22.415. To be qualified, a potential Recipient must:

- (1) Have the management capability and adequate financial and technical resources, given those that would be made available through the grant or cooperative agreement, to execute the program of activities envisioned under the grant or cooperative agreement;
- (2) Have a satisfactory record of executing such programs or activities (if a prior Recipient of an award);
- (3) Have a satisfactory record of integrity and business ethics; and
- (4) Be otherwise qualified and eligible to receive a grant or cooperative agreement under applicable laws and regulations (see 32 CFR 22.420(c)).

Applicants are requested to provide information with proposal submission to assist the

Grants Officer's evaluation of Recipient qualification.

In accordance with OMB guidance in parts 180 and 200 of Title 2, CFR, it is DoD policy that DoD Components must report and use integrity and performance information in the Federal Awardee Performance and Integrity Information System (FAPIIS), or any successor system designated by OMB, concerning grants, cooperative agreements, and TIAs as follows:

If the total Federal share will be greater than the simplified acquisition threshold on any Federal award under a notice of funding opportunity (see 2 CFR 200.88 Simplified Acquisition Threshold):

(5) The Federal awarding agency, prior to making a Federal award with a total amount of Federal share greater than the simplified acquisition threshold, will review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313);

(6) An applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a Federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM;

(7) The Federal awarding agency will consider any comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as described in 2 CFR 200.205 Federal awarding agency review of risk posed by applicants.

F. AWARD ADMINISTRATION INFORMATION

Award Notices

Should your Proposal be selected for award, you will be contacted telephonically or via email by the Grants Officer or his/her representative to discuss additional information required for award. This may include representations and certifications, revised budgets or budget explanations, and other information as applicable to the proposed award. The anticipated start date will be determined at that time.

The award document signed by the Government Grants Officer is the official and authorizing award instrument.

Administrative and National Policy Requirements

- a. Each award under this announcement will be governed by the general award terms and conditions in effect at the time of the award that conform to DoD's implementation of OMB guidance applicable to financial assistance in 2 CFR part 200, "Uniform Administrative Requirements, Cost Principles, and Audit

Requirements for Federal Awards.” The DoD Research and Development General Terms and Conditions (latest version, JULY 2018) are located at <https://www.onr.navy.mil/Contracts-Grants/submit-proposal/grants-proposal/grants-terms-conditions>. These terms and conditions are incorporated by reference in this announcement.

- b. You must comply with all applicable national policy requirements. The key national policy requirements that may relate to an award under this FOA are included in the terms and conditions specified in paragraph 2.a above.
- c. By electronically signing the SF-424, the applicant affirms its agreement with the following certification.

Certification Required for Grant and Cooperative Agreement Awards

The certification at Appendix A to 32 CFR Part 28 regarding lobbying is the only certification required at the time of application submission for a grant or cooperative agreement award. The certification is as follows:

“By signing and submitting an application that may result in the award of a grant exceeding \$100,000, the prospective awardee is certifying, to the best of his or her knowledge and belief that:

- (1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employ of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit SF-LLL, “Disclosure of Lobbying Activities” in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, and loans, or cooperative agreements) and that all Subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this

certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails the required certification shall be subject to a civil penalty or not less than \$10,000.00 and not more than \$100,000.00 for each failure.

d. Representations Required for Grant and Cooperative Agreement Awards

Appropriations Provisions on Tax Delinquency and Felony Convictions

Check either “is” or “is not” for each of these two representations, as appropriate for the proposing institution, include the AOR signature and point of contact information, and attach the representation page to Field 12 of the SF-424 Research & Related Other Project Information form. The page for these representations is provided with the application materials that are available for download at Grants.gov. Representations:

The applicant is () is not () a “Corporation” meaning any entity, including any institution of higher education, other nonprofit organization, or for-profit entity that has filed articles of incorporation. If the applicant is a “Corporation” please complete the following representations:

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

(2) The applicant represents that it is () is not () a corporation that was convicted of a criminal violation under any Federal law within the preceding 24 months.

NOTE: If an applicant responds in the affirmative to either of the above representations, the applicant is ineligible to receive an award unless the agency suspension and debarment official (SDO) has considered suspension or debarment and determined that further action is not required to protect the Government’s interests. The applicant therefore should provide information about its tax liability or conviction to the agency’s SDO as soon as it can do so, to facilitate completion of the required considerations before award decisions are made.

OMB CONTROL NUMBER: 0704-0494
OMB EXPIRATION DATE: 11/30/2019

AGENCY DISCLOSURE NOTICE

The public reporting burden for this collection of information is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden

estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Washington Headquarters Services, Executive Services Directorate, Directives Division, 4800 Mark Center Drive, East Tower, Suite 02G09, Alexandria, VA 22350-3100 [0704-0494]. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements

Agreement with the representation below will be affirmed by checking the “I agree” box in block 17 of the SF-424 (R&R) as part of the electronic application submitted via Grants.gov. The representation reads as follows:

By submission of its application, the applicant represents that it does not require any of its employees, contractors, or Subrecipients seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting those employees, contractors, Subrecipients from lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information

Note that: (1) the basis for this representation is a prohibition in Section 743 of the Financial Services and General Government Appropriations Act, 2015, Pub. L. 113-235) on provision of funds through grants and cooperative agreements to entities with certain internal confidentiality agreements or statements; and (2) Section 743 states that it does not contravene requirements applicable to SF-312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

G. AGENCY CONTACTS

All questions or comments concerning this FOA should be submitted on or before (see Event timeline above). Questions and comments should be concise and to the point. In addition, the relevant part and paragraph of the FOA must be referenced. Responses to non-proprietary questions received by the specified date will be posted to the SARA website for the benefit of all interested parties. Should an Applicant have questions they believe are of a proprietary nature, the Applicant must clearly state so and identify and mark the proprietary information in the question when submitted. Answers to questions of a proprietary nature will be provided via email directly to the requestor of the question and not posted on the SARA website.

H. OTHER – HUMAN SUBJECTS

Assistance Instruments:

- a. The Recipient must protect the rights and welfare of individuals who participate as human subjects in research under this award and comply with the requirements at 32 CFR part 219, Department of Defense Instruction (DoDI) 3216.02, 10 U.S.C. 980, and when applicable, Food and Drug Administration (FDA) regulations.
- b. The Recipient must not begin performance of research involving human subjects, also known as human subjects research (HSR), that is covered under 32 CFR part 219, or that meets exemption criteria under 32 CFR 219.101(b), until you receive a formal notification of approval from a DoD Human Research Protection Official (HRPO). Approval to perform HSR under this award is received after the HRPO has performed a review of the Recipient's documentation of planned HSR activities and has officially furnished a concurrence with the Recipient's determination as presented in the documentation.
- c. In order for the HRPO to accomplish this concurrence review, the Recipient must provide sufficient documentation to enable his or her assessment as follows:
 - i. If the HSR meets an exemption criteria under 32 CFR 219.101(b), the documentation must include a citation of the exemption category under 32 CFR 219.101(b) and a rationale statement.
 - ii. If the Recipient's activity is determined as "non-exempt research involving human subjects", the documentation must include:
 - Assurance of Compliance (i.e., Department of Health and Human Services Office for Human Research Protections (OHRP) Federal Wide Assurance (FWA)) appropriate for the scope of work or program plan; and
 - Institutional Review Board (IRB) approval, as well as all documentation reviewed by the IRB to make their determination.
- d. The HRPO retains final judgment on what activities constitute HSR, whether an exempt category applies, whether the risk determination is appropriate, and whether the planned HSR activities comply with the requirements in paragraph (a) of this section.
- e. The Recipient must notify the HRPO immediately of any suspensions or terminations of the Assurance of Compliance.
- f. DoD staff, consultants, and advisory groups may independently review and inspect the Recipient's research and research procedures involving human subjects and, based on such findings, DoD may prohibit research that presents unacceptable hazards or otherwise fails to comply with DoD requirements.
- g. Definitions for terms used in this article are found in DoDI 3216.02.