

SARA CRA Sprint 4 Q&A

Q1. We are a non-profit Department of Defense federally funded research and development center (FFRDC). Should our application result in an award, would it be possible to fund us through an Interagency Agreement?

Answer: Please see the instructions in the FOA for directions involving eligibility of FFRDCs. The type of agreement would need to be discussed if selected for award.

Q2. Can I propose for SARA if I have submitted a proposal for TBAM?

Answer: Yes. Evaluation and selection of proposals are conducted according to the published timelines for each CRA. If a proposal to one CRA is selected and the same personnel are proposed to work on the other CRA, this will be taken into account during evaluation of the second proposal to ensure that the personnel allocation is reasonable.

Q3. Is it safe to assume a cycle 4 proposal has no bearing on the cycle 3 option years if the topic areas are significantly different?

Answer: Participation in Sprint 3 will not affect the evaluation of a Sprint 4 proposal; however, if the same personnel and resources are applied to both efforts, that allocation must be reasonable.

Q4. What if I receive a Sprint cycle 4 award and then I move to a different organization? Suppose that a proposal is awarded, but the PI needs to move to a new institution. Can the award move with the PI to the new institution? Suppose that this happens before any documents are signed or any money is transferred. What happens? Suppose that this happens after the money is transferred. What happens in this case?

Answer: The Recipient is the entity receiving the Award, not an individual person executing the Award such as a Principal Investigator or other Key Personnel. The Recipient is responsible for identifying a change in personnel in order to maintain the award.

Q5. Sub-topic 1 is planning and algorithm centric. While Sub-topic 2 is dependent on having a legged platform physically or in simulation. If we focus on sub-topic 1 with a clear plan to integrate that planning idea to SARA, would it be acceptable? Or do we have to include sub-topic 2 as well to our proposal?

Answer: The Sprint 4 sub-topics are distinct. Applicants may propose to a single Sub-topic or both Sub-topics at the same time. Proposals must clearly state the Sub-topic being addressed. Both Sub-topics require access to a robotic testbed platform.

Q6. Our organization may require the Award to adhere to the “fundamental research exclusion.” That is, research qualifying as “fundamental research” is not subject to export controls. Can this exclusion be expected in a SARA Award?

Answer: The intent of this program is to conduct fundamental research not subject to export controls. However, our award terms do not address export control requirements as that is a fact-dependent situation which could arise in the course of research. Our award includes terms supporting an open publication policy. However, our award also includes language addressing Controlled Unclassified Information (CUI) which are triggered only if CUI is needed for performance under the award.

Q7. Would the university’s work be fundamental research?

Answer: The intent of this program is to conduct fundamental research not subject to export controls.

Q8. Does the project involve ITAR technology and/or EAR controlled technical data? If so, what are the Export Control Classification Numbers?

Answer: The intent of this program is to conduct fundamental research not subject to export controls. However, our award terms do not address export control requirements as that is a fact-dependent situation which could arise in the course of research. Our award includes terms supporting an open publication policy.

Q9. Is there a publication approval, review or restriction? What is the specific publication language?

Answer: Publications that include ARL authors, which is encouraged by the program, and those that include data that was generated at ARL facilities or from ARL testbeds must go through ARL’s Public Release process prior to public release.

Q10. Does the project require the university to meet NIST 800-171 controls to handle Controlled Unclassified Information?

Answer: Our award includes terms supporting an open publication policy. However, our award also includes language addressing Controlled Unclassified Information (CUI) which are triggered only if CUI is needed for performance under the award. There is potential for production of CUI information during the performance; however, to date that occurrence is rare. If CUI is produced, the NIST 800-171 Rev. 2 is the standard that recipients must meet.

Q11. For the ARL ground stack, will a software interface document (ICD) be provided to each team?

Answer: Awardees will receive documentation for access to and use of the autonomy stack, associated software and tools. Awardees will receive access to the autonomy stack repository, which includes a

developer manual describing core concepts and architectures of the ARL Autonomy Stack, and tutorials that demonstrate how to set up the appropriate configuration files for a new robot, new sensor, and more, both in simulation and on a robot.

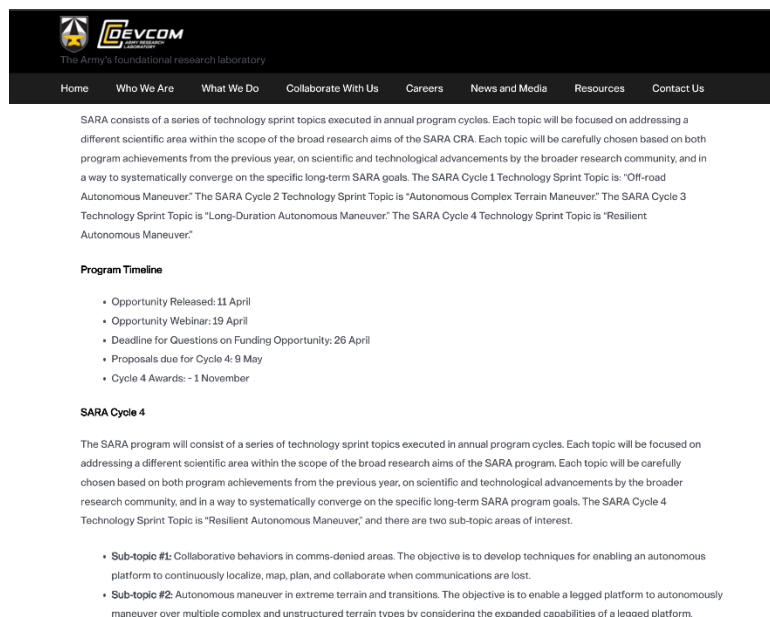
Q12. Is there a continuous integration setup on the ARL GitLab repo where we can submit our code for review?

Answer: Yes, it is an expectation that PIs will upload code on a regular basis.

Q13. Will each team be assigned a POC to meet on a regular bi-weekly or monthly cadence to provide updates, code reviews, etc.?

Answer: Yes, ARL SMEs will be assigned to each project to collaborate and facilitate.

Q14. The final submission date on the program webpage is 9th of May (image below) – in the FOA is 10th of May. Kindly clarify what is the actual date.



Answer: The due date for proposals has been updated and appears on grants.gov and <https://arl.devcom.army.mil/cras/sara-cra/>.

Q15. The "submit" button on the grants.gov website is not working, is this something that can be fixed? Otherwise, can we submit our proposal via email?

Answer: Upon review, the features on grants.gov appear functional. Issues regarding functionality of the site should be raised to the grants.gov help desk.

Q16. How many awards are expected for this cycle?

Answer: The number of awards is determined by the number of selected proposals and the available funding for the opportunity.

Q17. What is the expected proposal cost?

Answer: There is not a typical or target award amount. The FOA states an upper limit on available funds and indicates multiple awards are expected to be funded out of Cycle 4 (at the discretion of the Government). In general, budgets should follow from the requirements of the proposed research to answer the sub-topic in accordance with the Applicant's vision. In Sprint 1, Awards ranged from roughly \$100K to over \$700K, in Sprint 2 Awards ranged from roughly \$200K to over \$600K, and in Sprint 3 Awards ranged from roughly \$100K to \$700K – all dependent on the level of effort proposed, material, equipment, and type and quantity of personnel, among other factors.

Q18. In the webinar, I heard that the budget of an individual team is capped about \$700k. May I confirm that number?

Answer: See the answer to Q17.

Q19. The SARA call mentions that a total funding of \$2.5M for Cycle 4 is expected, and that multiple awards are expected to be funded. Does the \$2.5M figure include only the seedling period (one year) or the entire period of performance, including options?

Answer: The cited funding level of \$2.5M is for one year across all selected seedling projects.

Q20. Should the budget and proposed work be prepared for just a one-year effort or for multiple years (considering the possibility of annual extensions)?

Answer: The proposal should include budgets for the base and option years.

Q21. Is SARA evaluation tailored towards university partnerships?

Answer: All eligible entities may submit a proposal to SARA Sprint cycle 4. As long as the Applicant meets the eligibility criteria identified in the FOA, their proposal will be accepted for consideration and evaluation. Proposals must clearly state which Sub-topic or Sub-topics are being addressed. All evaluations will be made against the stated evaluation factors.

Q22. We are considering proposing with colleagues at a government lab. The question for you is, is the government lab eligible for this solicitation? The eligibility information on Page 23 of the rev4 document does not explicitly call out other DoD research entities.

Answer: A government laboratory is not eligible for this solicitation. However, a proposal can be submitted by an eligible entity with a government laboratory participating with the eligible entity under an appropriate authority, such as 15 USC 3710a or with the government laboratory participating with ARL.

Q23. What are your suggestions on collaborative proposals? In this case, would the lead institution only should submit the proposal?

Answer: Proposals may include collaborators. One institution must be identified as the lead/primary, and any other institutions will be considered by ARL as Subawardees. The proposal must allow ARL to evaluate the proposed effort against all evaluation factors. See the FOA Chapter 3: Cost Component paragraph 10 on how to include Subawardees if the subaward amount is greater than or equal to \$10,000.

Q24. As a university + government lab team, if awarded, will each sub-team be funded directly by ARL? or will only the PI institute be funded by ARL?

Answer: The funding structure will depend on how the eligible entity is working with the government laboratory. See the answer to Q22 and Q23.

Q25. What are the expectations on the teaming/collaboration aspects (between multiple institutes) for the seedling proposals? And can you please provide some budget guidance?

Answer: Cross-project collaboration is only encouraged, not required. A proposal is not expected to include a collaboration plan that includes other SARA CRA projects. Multiple organizations may submit a joint-proposal (also see the answer to Q24). All evaluations will be made against the stated evaluation factors. There is no requirement to team with one or more institutes on a SARA Proposal.

Q26. Are there restrictions on personnel who can work on a SARA Award? (e.g., foreign nationals or green card holders only?) If so, what is the specific language?

Answer: There are no Citizenship restrictions for who can work on a SARA Award. Visitors to ARL facilities will undergo a background investigation, results which will be used to determine if access is authorized. If access is denied for an individual, the ARL and Recipient PIs will determine suitable courses of action to successfully complete onsite activities in the absence of denied personnel. Further, proposals are subject to the Army Research Risk Assessment Program which takes into consideration several factors, listed in the FOA, for Senior/Key Personnel and covered individuals. Nationality or Citizenship is not a factor in the risk assessment.

Q27. Could the existing capabilities of ground and aerial platforms be expanded upon or a reference describing the capabilities provided? (e.g. Action primitives "loiter", "land", "return to base"). FOA Ref: "ARL Air Autonomy Architecture".

Answer: For the UAS architecture, our current supported task types are:

- Idle (hover or idle on ground)
- Land in place
- Return to launch
- Orbit
- Search
- Precise land on fiducial marker
- Takeoff
- Goto
- Stare

These are modular and use a behavior tree architecture so creating derivative behaviors is straight forward.

A description of the UGV testbed, the autonomy software stack, and the autonomy hardware stack are provided in the Sprint 4 FOA and Webinar slides.

Q28. Sub-topic # 1 - Can some indicative examples of communication loss be provided?

Answer: Examples include jamming, interference from environmental features, antenna problems. These communication disruptions could be intermittent or constant; could affect an entire team or individual members; and could be at a mission control level and/or at the team level.

Q29. Would validation in virtual environments be acceptable for the desired capabilities? Specifically, being able to set things up in the ARL virtual platform to demonstrate viability of our proposed approach? I ask because given the cost of licensing for non-commercial UAVs and the cost and overhead of the commercial ones.

Answer: The intent of a virtual environment on the SARA program, for example those available in the ARL Ground and Air Autonomy Stack environments, is for basic validation of component and system performance before moving into flight experiments. The preference is for the work to result in live experimentation. The ARL R2C2 GQ facility is capable of supporting Group I and II rotary wing UAS. In rare cases virtual results can suffice. In regard to platform costs, ARL has government owned reference platforms, or can offer relatively low-cost commercial development platforms.

Q30. Regarding Sub-Topic #1, could the ARL provide an example, expectation, or insight into what a "baseline" mission would look like? What form would the example objectives and measures take? Could

this framework specify how the agents receive mission descriptions, commands, and goals (e.g., as a language description, waypoints, etc.)? FOA Ref: “The team has received commands and goals (i.e., objective A).” and “Autonomous systems receive a baseline mission including objectives and measures”.

Answer: The baseline mission in this context is the original mission that the team is working on, and for the SARA program this surrounds the need to maneuver. Particular baseline mission scenarios are not prescribed for the SARA program or for a particular sprint; but may be proposed and used as part of an awarded effort. To provide context, it may consist of maneuver through and/or to an area for the purposes of surveillance, security, resupply, or other operations. The applicant can assume use of existing capabilities for mission planning and execution and can develop new and modified capabilities as part of the autonomy stack development. Mission description, commands, and goals can consist of metric and/or semantic information. The forms of measures typically relate to performance toward a goal or sub-goal: e.g. accuracy toward the objective/goal, planning and re-planning time, time to goal/failure, % of progress, level and frequency of intervention, efficiency. The applicant is free to propose measures.

Q31. Regarding Sub-Topic #1, how does the ARL expect that communications will be used in the completion of this “baseline mission” or a single “objective” of the baseline mission? Could an example be given of how this communication will be used in completion of a baseline mission objective? (i.e., Why is mission success conditioned on the presence of communications?) FOA Ref: “The team has received commands and goals (i.e., objective A).” and “Autonomous systems receive a baseline mission including objectives and measures”.

Answer: The assumption is that the team members will share information in order to complete a mission. For example, if the mission is to map an area, with individual team members collaborating to map portions of that area, information on the progress and completion of those mappings is shared. In event of a change in mission (e.g. the area to be mapped changes) the assumption is that new mission objectives would be communicated to the team members.

Q32. Regarding Sub-Topic #1, is there an underlying assumption that some components of autonomous maneuvers require constant communication with a base station or a human operator? Is the intent of this guiding question to indicate that information must be shared with a human agent at some point (or all points) during the mission? FOA Ref: “What are the initial conditions of agents in the scene? How will you define this and share it with humans and other agents?”

Answer: No, there is not a requirement for constant communications. Yes, the assumption is that information will be shared among team members during the mission (also see the answer to Q31). The guiding questions are suggestions of ideas for context of sub-topic 1.

Q33. Regarding Sub-Topic #1, could the ARL provide some examples of or context to the notion of “collaboration”? For instance, would you require two or more agents to collaborate on a single “objective” for it to be satisfied or can each “objective” be satisfied by a single agent? FOA Ref: “At least

two agents must collaborate; at least one mobile robotic autonomous system with ability to interact with others, but not all agents in the scene need to be mobile robotic autonomous systems.” and “Autonomous systems receive a baseline mission including objectives and measures.”

Answer: The assumption is that satisfaction of objectives can be performed by individual team members and/or collectively. For example, if a mission objective is to perform tasks efficiently, there could be negotiations on which members will perform tasks based on current locations, onboard capabilities of individual members, and progress updates by members to the team.

Q34. Regarding Sub-Topic #1, is the evaluation of mission completion determined by an independent oracle/observer or reported by the agents themselves? FOA Ref: “Percent of mission completion and reasons for incompleteness”

Answer: The intent is to measure mission progress and completion using a combination of observation and data from the agents. Ideally, we will identify ground truth on mission performance and compare that to the reported performance by the agents.

Q35. Regarding Sub-Topic #1, could the ARL expand on the evaluation of this metric? Are missions expected to have objectives that have conditional completion requirements (e.g. completed sequentially)? FOA Ref: “Percent of mission completion and reasons for incompleteness”.

Answer: The assumption is that mission objectives could have dependencies, but this is not required. Partial completion of an objective could have merit and the number of completed objectives could be a metric.

Q36. Sub-topic # 1 – Is maximization of area coverage one of the objectives for the robot team to optimize? If so, does it apply only at search area B? or even during the transact between point A to point B?

Answer: The type of operation is not specified; therefore, the proposed work may include coverage and it is reasonable to assume that this could be relevant en route and at the objective.

Q37. Sub-topic # 1 - is it expected that the solution proposed to include the development of a multi-agent SLAM capability?

Answer: There is no requirement for a multi-agent SLAM component per se; however, a proposal may include this component. Experimental multi-agent SLAM will be offered in the ARL Autonomy Stack. Recipients are expected to mature existing approaches and develop new solutions. Contributions to the Air and Ground architectures come in three possible ways: Replace, Add, or Modify as described on pages 12 and 13 of the FOA.

Q38. Sub-topic # 1 - Is it a valid assumption that the current SARA Phoenix software stack has some multi-agent SLAM capability?

Answer: Experimental multi-agent SLAM will be offered in the ARL Autonomy Stack.

Q39. In the webinar early this week, I learned that research aims can address problems in both Topics. Since Topic 1 is about collaborative behaviors, I wonder if biped or humanoid robots fit into the overall scope of this Sprint. Alternatively, would including a humanoid robot alongside quadruped robots be within scope?

Answer: The scopes for sub-topic #1 and sub-topic #2 are distinct. Unless the purpose of proposing bipedal mobility, or other modes, is to address the challenges posed to collaborative behaviors in communications-denied scenarios, it would not be applicable for sub-top #1. For sub-topic #2, we are interested in focusing on quadrupedal agents during this sprint. Humanoid form factors may become of interest in future sprints.

Q40. For subobjective 2, can we propose using our own quadrupedal robots or even create a novel testbed to be built/modified to better adapt to different terrains?

Answer: Yes, you may propose using your own quadrupedal robots for developmental purposes, but the algorithms must be relevant to the ARL platforms and ultimately have a path to integration onto our platforms. We are not interested in novel testbeds at this time.

Q41. Are we permitted to use Unitree quadruped platforms for subtopic #2? These are manufactured in China and less capable than the Ghost Robotics V60 but allow access to low-level joint control for locomotion research.

Answer: Alternative research platforms for use at the performer's location is permitted. The proposal must show that there is a path for integrating the developed capabilities onto the ARL Autonomy Stack and the standard legged platforms used by ARL (currently the Boston Dynamics Spot and Ghost V60). This integration path must be demonstrated during the base year for consideration of exercising an option.

Q42. If we plan to use quadrupedal robots in our own lab during Year 1, are we allowed to use Unitree quadruped robots from China? I heard that Army might have some restrictions on using hardware from China. We are curious about any potential restrictions regarding the use of Unitree robots.

Answer: See the answer to Q41.

Q43. Dynamic quadrupeds like Spot and Ghost have limited payload and severely reduced endurance compared to dismounted infantry. Would ARL entertain a proposal that employs a hybrid wheel-on-limb quadruped platform to overcome complex terrain, but improves these two metrics, assuming it would be demonstrated at R2C2?

Answer: While the hybrid design is interesting, we are unwilling to consider those morphologies within the scope of this sprint. Ultimately, we are looking for solutions that have a path to integration onto our platforms (currently Boston Dynamics Spot, Ghost Robotics Vision-60), and we do not at present have plans to pursue that morphology in-house.

Q44. I understand that for sub-topic #2, it is not recommended to purchase Boston Dynamics Spot robots. If we have our own Spot robot platform, are we allowed to purchase on-board computers and sensors to match the ARL platforms from the proposal funding?

Answer: Applicants may include cost estimates and quotes for hardware in their proposals. ARL will consider cost reasonableness under evaluation factor #4. Disposition of hardware purchased with ARL funding will be in accordance with the applicable regulations.

Q45. Do the planned legged robot capabilities have to work on all quadrupeds (i.e. both Spot and Vision 60)? Or, is it OK if some capabilities would only be compatible with one of these platforms (or even capabilities that go beyond what these specific quadrupeds are capable of)?

Answer: Ideally, solutions would work cross-platform (i.e. both), but we are willing to consider capabilities that may only be compatible with one of the platforms given good justification. Solutions that go beyond the capabilities of these specific quadrupeds to the point of being irrelevant on them are unlikely to be competitive given our needs.

Q46. Does biped (e.g., humanoid robots) fit the scope of topic 2? Or can having a humanoid robot as a part of the team with quadruped robots be within the scope?

Answer: Biped/humanoid robots do not fit the scope of Topic 2 for the purposes of this sprint.

Q47. How does the quadruped control fit into the autonomy stack? I did not see any mention of any quadruped-specific details under "ARL Ground Autonomy Architecture". Does the architecture currently support legged robots at all, and if so what components or interfaces should we be aware of when developing our plans?

Answer: ARL's autonomy stack does not currently contain quadruped-specific controls but has been successfully integrated onto quadrupeds for higher level functions. Lower-level, quadruped-specific functions are a work in progress, including working with platform vendors.

Q48. It looks that the existing autonomy stacks are mainly for air and wheeled ground robots. For legged robots, does the program expect to reuse the existing autonomy stacks as much as possible and then modify the modules and tailor them to legged robots?

Answer: Yes, that is our plan and expectation. See the answer to question 47.

Q49. For topic 2, the topics of interest mention "reinforcement learning" for motion planning and control methods. Does this mean the program is more inclined to RL methods rather than model-based approaches?

Answer: No, we are equally interested in model-based and RL-based approaches and are happy to consider proposals using either approach (or both, or neither/other approaches). Our intention was only to make clear that we are willing to consider RL approaches in addition to other (e.g. model-based) approaches. Any emphasis on RL was unintentional; proposals are open to any control methodology.

Q50. The topics of interest mention "reinforcement learning" for motion planning and control methods. Does this indicate a preference of RL methods over model-based approaches? If we propose a hybrid approach that combines both RL and model-based approaches, would that be equally competitive compared to pure RL approaches in general?

Answer: See the answer to Q49.

Q51. Is the SARA program interested in incorporating Ultra-Wideband (UWB) technology as an additional sensing modality in the ARL autonomy stack and is the program open to ideas that harness RF ranging and communication for Cycle 4.

Answer: The envisioned deliverables for the Sprint 4 sub-topics do not call for the addition of sensor modalities as the basis of a proposal; however, may include them. Any additional, COTS, custom, or novel sensor purchases need to be budgeted in the proposal as cost reasonableness will be a factor in the evaluation. Proposed UAS components must be appropriate for the size and lift capacity of the aircraft and must be NDAA compliant.

Q52. Both Sub-topics for Cycle 4 emphasize techniques of autonomy rather than techniques for testing and evaluation of autonomy. Would a proposal focused on advancing the state of the art for testing and evaluation of resilient autonomous maneuvers be in scope for this funding opportunity?

Answer: T&E research is out of scope for Sprint 4.

Q53. As you mentioned in the webinar, human-robot teaming is one of the directions of interest to SARA. In addition to the autonomy of robots, do you think research involving human modeling to address human-robot collaboration with minimal communication might align with the scope of Sprint 4?

Answer: Research specific to human modeling is outside of the scope for SARA CRA Sprint 4. There are other ARL CRAs which may be better suited to proposals addressing human modeling.

Q54. The topic of HRI wasn't explicitly assigned as a sub-topic in Sprints 1-4. Does this mean it can potentially be proposed for all sprints? Or do you envision a specific sprint in the future dedicated to studying this topic?

Answer: Proposals are expected to address the sub-topics of the current sprint. Applicants may propose to a single Sub-topic or both Sub-topics at the same time. Proposals must clearly state the Sub-topic being addressed. There is not opportunity to award proposals that address topics from previous sprints. Future sprint topics are determined by the current state-of-the-art and knowledge of technology gaps at the time; and these topics are not forecasted.