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A. REQUIRED OVERVIEW CONTENT

1. **Agency Name:** 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:** Distributed and Collaborative Intelligent Systems and Technology (DCIST) Collaborative Research Alliance (CRA)

3. **Announcement Type:** Initial

4. **Research Opportunity Number:** W9111NF-17-S-0004

5. **Catalog of Federal Domestic Assistance (CFDA) Number(s):** 12.630 - "Basic, Applied, and Advanced Research in Science and Engineering"

6. **Response Dates:** The following is a summary of the events and dates associated with the DCIST CRA Program Announcement (PA):

EVENT	ESTIMATED DATE/TIMEFRAME
PA released	21 February 2017
Opportunities Conference	1 March 2017
Deadline for Questions on PA	1 April 2017
Whitepapers due	28 April 2017
Whitepaper Feedback/Invitation to Submit Full Proposal	Early June 2017
Full Proposals due	14 July 2017
Award	September 2017

B. ADDITIONAL OVERVIEW INFORMATION

Purpose: The United States Army Research Laboratory (ARL) has established an enterprise approach to intelligent systems that couples multi-disciplinary internal research, analysis, and operations with extramural research and collaborative ventures. The purpose of this **Program Announcement (PA)** is to solicit proposals to establish a new collaborative venture – The Distributed and Collaborative Intelligent Systems and Technology (DCIST) Collaborative Research Alliance (CRA) – that seeks to advance the theoretical foundations of intelligent systems science and help fulfill the research and development goals of the U.S. Department of the Army. The PA is expected to result in a single award to a Consortium of organizations, led by an institution of higher education, that may include institutions of higher education, industrial (large and small businesses) and non-profits entities.

The objective of this CRA is to perform enabling basic and applied research to extend the reach, situational awareness, and operational effectiveness of large heterogeneous teams of intelligent systems and Soldiers against dynamic threats in complex and contested environments and provide technical and operational superiority through fast, intelligent, resilient and collaborative behaviors. To achieve this, ARL is requesting proposals that address three key Research Areas (RAs):

> **RA1: Distributed Intelligence**: *Establish the theoretical foundations of multi-faceted distributed networked intelligent systems combining autonomous agents, sensors, tactical super-computing, knowledge bases in the tactical cloud, and human experts to acquire and apply knowledge to affect and inform decisions of the collective team.*
>
> **RA2: Heterogeneous Group Control**: *Develop theory and algorithms for control of large autonomous teams with varying levels of heterogeneity and modularity across sensing, computing, platforms, and degree of autonomy.*
>
> **RA3: Adaptive and Resilient Behaviors:** *Develop theory and experimental methods for heterogeneous teams to carry out tasks* under the dynamic and varying conditions *in the physical world.*

It is expected that strong links will exist across RA1, RA2, and RA3. To achieve the CRA's vision, the DCIST CRA is expected to build new collaborative relationships and develop mutual understanding across organizations, technical and scientific disciplines, and the three RAs. ARL strongly believes that a joint collaborative approach by a multidisciplinary research team is required to make fundamental advances towards meeting the CRA goal to develop a fundamental understanding of highly distributed and collaborative intelligent systems. The Consortium, selected for award, and ARL will form an Alliance working jointly to solve complex problems to address research topics critical to DCIST. Collaboration, across the Alliance, is integral to the execution and success of the CRA.

Award Instrument: This PA is expected to result in the award of a cooperative agreement (CA) as defined at 31 U.S.C. 6305 for the execution of the program. The CA will be

awarded to a Consortium of organizations that may include institutions of higher education, and industrial and non-profit organizations.

The Consortium must be led by an institution of higher education charged with spearheading the focused basic research program. This organization will be designated as the Lead Research Organization (LRO). Each Research Area will be led by a different Lead Research Area Organization (LRAO), one of which could also be the LRO. The same entity cannot be the LRAO for more than one Research Area. Together the LRO and LRAOs make up the Consortium, who are responsible for shaping and steering the CRA through collaboration, with ARL. Performance under the CA may also include other organizations as subawardees to the LRO. To assure the creation of a well-focused research program, the number of partners should balance the need for expertise in all three Research Areas and the Cross Cutting Research Issue with the need to maintain a focused, cohesive, well-integrated research program.

Proposal Submission: The application process (**see Section II.D)** consists of a Whitepaper stage and a Proposal stage. The purpose of requesting Whitepapers is to minimize the effort associated with the production of detailed proposals for those Applicants that have little chance of being selected for funding. The Government's decision to invite a Proposal will be based upon the evaluation results of the Whitepaper submission. Only the most highly rated Whitepapers will receive an invitation from the Government to submit a Proposal. **An Applicant that does NOT receive an invitation from the Government to submit a Proposal is NOT eligible to submit a Proposal and will NOT receive feedback or a "debriefing" on their Whitepaper.** An Applicant invited to submit a Proposal will receive feedback on their Whitepapers in order to improve their Proposal submission. **Applicants who have NOT submitted a Whitepaper, are NOT eligible to submit a Proposal.** Applicants should note there are page limitations and other requirements associated with the submission process for both the Whitepaper and the Proposal. Submissions in connection with this PA are due by the date and time specified in **Section. II.D**.

Period of Performance: The Award made as a result of this PA will provide for a period of performance of five years, with an optional five-year extension period.

Place of Performance: There is no limitation on the place of performance for any organization participating under the CA. Given the collaborative nature of the program, significant staff rotations, of both short and long-term durations amongst the Alliance are expected, including a Consortium presence located with ARL.

Funding: This PA is issued subject to the availability of funds. ARL has submitted the requisite documents to request funding for the period covered by the CA. However, Applicants are reminded this request for funding is subject to Presidential, Congressional and Departmental approval. The PA provides the estimated funding levels for the Basic Research (6.1) for the DCIST CRA. **The funding levels provided in the PA are for Whitepaper and Proposal preparation purposes only. The actual funding level of the CA will be updated annually as part of the appropriation process.** Further, this PA

identifies additional levels of funding to potentially enhance the research program with additional basic and applied research funds. It is expected that during performance there will be opportunities to secure this additional funding from ARL or other Government agencies to enhance the core basic research program.

Profit/Fee: In accordance with 32 Code Federal Regulations (CFR) §22.205, profit/fee is not permitted under the CA for the recipient or any subawardees.

Cost Sharing: Cost sharing is not required under this PA. During the evaluation of proposals, any cost sharing will be evaluated as it relates to the evaluation factors listed in the PA, based on the degree to which the proposed cost sharing enhances the Proposal to result in added benefits to the DCIST CRA. To allow for evaluation of proposed cost sharing, a Proposal should express a firm commitment to provide such cost share and evidence **a process for integrating the cost share into the collaborative research program.**

Evaluation and Award: Whitepapers and Proposals that are in compliance with the requirements of the PA 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, managers and business specialists, will evaluate the Whitepapers and Proposals and provide the results of that evaluation to the decision maker for the Government. The decision maker will make both the decisions concerning the Whitepaper down selection and award selection.

Opportunity Days. An Opportunity Day will be held to discuss this PA and to encourage dialogue, interchange and teaming related to responding to the PA. The Opportunity Day will be held at US Army Research Laboratory, Adelphi, MD on Wednesday, 1 March 2017. While strongly encouraged, attendance at these meetings is not a requirement for submission of a Whitepaper or Proposal in connection with the DCIST CRA PA. Registration details can be found on the DCIST CRA Program website at www.arl.army.mil/cra/dcist/. The presentations from this meeting, the list of attendees, and the non-proprietary questions posed and answers provided will be made available on the above mentioned website. Nothing said during the Opportunity Day will change this PA. Any changes to this PA will be issued via an amended PA being posted in grants.gov.

Contact Information. Outside of questions posed at the Opportunity Day, all questions or comments concerning this PA shall be submitted to the Government through the DCIST CRA Program website at www.arl.army.mil/cra/dcist/. Comments or questions submitted should be concise and to the point, eliminating any unnecessary verbiage. In addition, the relevant part and paragraph of the PA to which a question pertains should be referenced. Responses to non-proprietary questions received will be posted to the DCIST CRA Program website under the “General Information/Questions & Answers" section for the benefit of all interested parties. All clearly identified and marked proprietary questions posed will be responded to via an individual email response. Applicants are encouraged to submit any questions as early as possible. The deadline for submission of questions which will be answered under this PA is 1 April 2017. Any answers provided to questions do not change

the requirements of this PA. Any changes to this PA will be issued via an amended PA posted in grants.gov.

II. DETAILED INFORMATION ABOUT THE FUNDING OPPORTUNITY

A. PROGRAM DESCRIPTION

1. ARL Vision

Army Operating Concepts and roadmaps to 2040 and beyond envision integrating intelligent systems as force multipliers for improving the effectiveness and reach of Soldiers in complex military relevant environments. Recent Army studies have identified that intelligent systems have the potential to deliver significant military value, including opportunities to reduce the number of warfighters in harm's way, increase the quality and speed of decision making in time-critical operations, and enable new missions that would otherwise be impossible.

Over the last ten years, the ARL has established an Enterprise approach to intelligent systems that couples multi-disciplinary internal research, analysis, and operations with extramural research and collaborative ventures through programs such as the Robotics Collaborative Technology Alliance (CTA), the Micro Autonomous Systems and Technology CTA, and Multidisciplinary University Research Initiatives. The vision of the Enterprise has been to make unmanned systems an integral part of the small unit team and to develop systems that: understand the environment; learn from experience; adapt to dynamic situations; possess a common world view; communicate naturally; conduct useful activity; and can act independently, but within well prescribed bounds. ARL has also been working to scale intelligent systems down in size and enable collaborative systems for realizable dismounted Soldier Intelligence, Surveillance, and Reconnaissance (ISR) assets.

In extending this vision to 2040 and beyond, it is also envisioned that future intelligent systems will need to exhibit adaptable levels of autonomy and work across large heterogeneous teams of intelligent agents and Soldiers. Teams are expected to have the ability to perceive and learn across highly distributed components, work in complex and contested environments, and assist in making rapid decisions in the presence of large amounts of data. The Intelligent Systems vision addressed by this PA is one that integrates, potentially large numbers of heterogeneous physical agents and Soldiers in the command structure as well as sensor nodes within the collective; that can access data from external sources such as distributed unattended sensors and information from knowledge bases; that can fuse information from these external sources with the distributed and heterogeneous perception abilities of the collaborative team to form and then distribute a collective situational awareness as needed and appropriate; and can then use the distributed and heterogeneous processing and intelligence capability of the team to make rapid, and potentially joint, decisions (both locally and globally) to optimize and adapt missions in the face of complex environments, unexpected events, and adversarial actions. Some basic assumptions are that the system will include:

- Large numbers of agents – tens to swarms

- Heterogeneous mix – air/ground, large/small, manned/unmanned, fast/slow, varying levels of cognition, Soldiers in the command structure as well as sensor nodes within the team, smart sensors, and knowledge sources
- Highly distributed deployment over large areas
- Operations in complex, dynamic, varying, and contested environments
- Rapid Operational Tempo to include potential for some components operating at faster than human tempo and decision making speeds

This vision for a highly distributed and collaborative approach for future intelligent systems will lead to extended reach, situational awareness, and operational effectiveness against dynamic threats in contested environments and technical and operational superiority through intelligent, resilient and collaborative behaviors.

While it is important to develop component technologies, this vision is not about a singular technology or system but rather how to integrate varying levels of autonomy and intelligence with the Soldier across spatially and temporally distributed singular systems, small teams, and even swarm behavior all under one command and control architecture. And, in doing so, augment the capability of the collective well beyond that of any one component within the collective to address the Army challenge of high tempo operation in complex, contested, and unknown environments with little or no supporting infrastructure.

Axes of Complexity and Overarching Research Questions:

The future Army will operate in challenging environments, and significant research gaps must be overcome to enable intelligent systems and autonomous agents to operate in such environments. Several axes of complexity limit the operational capability.

- Complexity of the physical environment and prior access or knowledge of the environment
- Availability of supporting infrastructure
- Operational tempo
- Ability and presence of peer adversaries

Environments, such as dense urban, pose severe challenges on mobility, perception, networking, and sensing. Limited prior access to the operational environment may limit the application of today's big-data learning approaches. The complexity of human behavior makes discerning noteworthy behaviors or formulating appropriate responses challenging. There may be little or no available infrastructure, such as power or networking. And, it is very challenging to operate at high rates with these constraints. The Army challenge is to operate in complex unknown environments, with little or no infrastructure, at a very high operational tempo.

Fundamental gaps exist in the understanding of collaborative intelligent systems, whose design and operation is complicated by increases in the following.

- Number of agents

- Degree of heterogeneity of the agents
- Agent complexity and adaptability
- Degree of communication among agents (both machine and human)

The overall vision of the DCIST CRA is to develop the fundamental science of collaborative intelligence to address these complexities and answer long range research questions such as, but not limited to, the following.

1) How can large distributed heterogeneous intelligent control systems be designed?
2) What are the foundations and design techniques for collective multi-agent coordination when humans act as agents within the mixed group?
3) How can intelligent behaviors and autonomous networking be coupled to provide seamless collaborative intelligent systems that are resilient to tactical network deficiencies, electronic warfare, and other sources of loss?
4) How can we teach large numbers of heterogeneous agents to do nontrivial collective tasks in real-time and in the physical world?
5) How can we build distributed collaborative intelligent systems that bridge control, signal processing, and detection / estimation theory with associative knowledge bases and deep learning neural architectures?

Programmatic Approach:

To achieve the CRA's vision, the DCIST CRA is expected to build new collaborative relationships and develop mutual understanding across organizations, technical and scientific disciplines, and Research Areas. ARL strongly believes that a joint collaborative approach by a multidisciplinary research team is required to make fundamental advances towards meeting the CRA goal to develop a fundamental understanding of highly distributed and collaborative intelligent systems. Collaboration between the Consortium and the Government is integral to the execution and success of the CRA. The Consortium will work collaboratively with ARL's internal research program and other ARL-led collaborative ventures, to identify areas where research can advance ARL's Intelligent Systems Enterprise long-term vision. Collaborative research, as well as transition links among the Alliance will also be pursued and defined through sharing of data and frequent technical exchanges including seminars, site visits, staff rotations, and maintaining a Consortium presence at ARL. The Alliance will also encourage mutual participation in formulating the research program, performing the research, and participating in technical reviews during the period of performance. This will strengthen the relevance of CRA research and enable the transition of research results.

The overall objective of the DCIST CRA is to develop the underpinning science to enable highly heterogeneous, distributed, and collaborative intelligent systems and Soldiers. To achieve this, ARL has identified three interrelated aspects or Research Areas of DCIST, that when jointly and interactively studied will advance the theoretical foundations of DCIST in the context of Army relevant scenarios.

The DCIST CRA is requesting proposals that address three key Research Areas (RAs) in:

RA1: Distributed Intelligence
RA2: Heterogeneous Group Control
RA3: Adaptive and Resilient Behaviors

Distributed Intelligence, Heterogeneous Group Control, and Adaptive and Resilient Behaviors are intricately linked and must be studied jointly. The proposed research must develop appropriate mathematical representations, metrics, models, experiments, and analysis techniques. This will lay the foundation for future systems that are expected to extend reach, situational awareness, and operational effectiveness against dynamic threats in complex and contested environments and technical and operational superiority through intelligent, resilient and collaborative behaviors.

It is understood that some research topics such as, but not limited to, robust autonomous networking, learning, and cross-disciplinary experimentation underlie and support all of these areas and are acceptable technologies and solutions to be integrated into the program as critical underlying common research themes. It is also understood that there are many other challenges associated with this problem space beyond the scope of funds available and the DCIST CRA is specifically not addressing challenges such as: cyber security, aero- and terra-mechanics or maneuverability of platforms, new sensor development, power solutions for extended mission life, or the internet of things. The focus of this program is on the key RAs and the underlying technologies needed to provide collective awareness, enable rapid decision making, control of the collective, and finally enable adaptive and resilient behaviors to ensure mission success.

2. ARL Internal Mission and Related Programs

The DCIST CRA will become an integral part of ARL's Enterprise in Intelligent Systems. Collaboration with the internal Intelligent Systems and Human-Agent Teaming research programs is critical to the CRA's success and interactions with other related ARL research programs may bring different insights to bear on the CRA's research problems.

ARL's Internal Mission

The U.S. ARL is the Army's corporate research lab whose mission is to provide the underpinning science, technology, and analysis that enable full-spectrum operations[1]. Five of the six Directorates of ARL -- the Computational and Information Sciences Directorate (CISD), the Human Research and Engineering Directorate (HRED), Sensors and Electron Devices Directorate (SEDD), Vehicle Technology Directorate (VTD) and the Weapons and Materials Directorate (WMRD) along with the Army Research Office (ARO) conduct research related to intelligent systems and human-agent teaming. Much of this research is focused under three of the ARL Research Campaigns: Sciences-for-Maneuver, Information Sciences, and Human Sciences. It is expected that CRA researchers will collaborate with researchers in these Directorates and across these research campaigns. ARL will

[1] www.arl.army.mil

specifically fund in-house staff to foster highly collaborative partnerships between Consortium and Government researchers.

A brief description of ARL's relevant organizations follows.

- **Computational and Information Sciences Directorate (CISD)** - Scientific research and technology focused on information processing, network and communication sciences, information assurance, and battlespace environments, and advanced computing that create, exploit and harvest innovative technologies to enable knowledge superiority for the Warfighter. CISD's technologies provide the strategic, operational, and tactical information dominance across the spectrum of operations.
- **Vehicle Technology Directorate (VTD)** - Scientific research and technology addressing propulsion, transmission, aeromechanics, structural engineering, and vehicle intelligence technologies for both air and ground vehicles.
- **Human Research and Engineering Directorate (HRED)** - Scientific research and technology directed toward optimizing Soldier performance and Soldier-machine interactions to maximize battlefield effectiveness, and to ensure that Soldier performance requirements are adequately considered in technology development and system design.
- **Sensors and Electron Devices Directorate (SEDD)** - Scientific research and technology in electro-optic smart sensors, multifunction radio frequency (RF), autonomous sensing, power and energy, signature management, directed towards reconnaissance, intelligence, surveillance, and target acquisition (RISTA), fire control, guidance, fuzing, survivability, mobility and lethality.
- **Weapons and Materials Research Directorate (WMRD)** - Scientific research and technology in the areas of weapons, protection, and materials to enhance the lethality and survivability of the nation's ground forces
- **Army Research Office (ARO)** - Initiates the scientific and far reaching technological discoveries in extramural organizations: educational institutions, nonprofit organizations, and private industry.

Full details about ARL's organization and strategic planning can be found on the ARL website:

https://www.arl.army.mil/www/default.cfm?page=20

Over the last ten years, ARL Autonomous Systems Enterprise has worked towards making unmanned systems an integral part of the small unit team through the Robotics Collaborative Technology Alliance (CTA), the Micro Autonomous Systems and Technology (MAST) CTA, and ARL's internal research programs. A goal of the enterprise has been to develop systems that: understand the environment; learn from experience; adapt to dynamic situations; possess a common world view; communicate naturally; conduct useful activity; and act independently within well prescribed bounds. It has also

been working to scale intelligent systems down and enable collaborative systems for realizable dismounted Soldier ISR assets. A brief description of ARL's relevant research under the Sciences-for-Maneuver, Information Sciences, and Human Sciences campaigns are as follows:

Sciences-for-Maneuver: Sciences-for-Maneuver is focused on gaining a greater fundamental understanding of advanced mobility systems and their supporting architectures – critical to the future Army's movement, sustainment, and maneuverability through Energy and Propulsion, Platform Mechanics, Platform Intelligence, and Logistics and Sustainability.

Information Sciences: Information Sciences is focused on gaining a greater understanding of emerging technology opportunities that support intelligent information systems that perform acquisition, analysis, reasoning, decision-making, collaborative communication, and assurance of information and knowledge through Sensing and Effecting, System Intelligence and Intelligent Systems, Human and Information Interaction, Networks and Communications, and Cyber Security.

Human Sciences: Human Sciences is focused on understanding and improving individual and small unit performance across the full range of military operations; empowering leaders with enhanced cognitive capabilities to make sound decisions quickly; and integrating humans and intelligent technology to effectively enable expeditionary forces to shape the operational environment.

Full details and a full listing of related ARL campaigns can be found on the ARL website:

https://www.arl.army.mil/www/default.cfm?page=2512

Related CTA/CRA Programs at ARL.

- **Micro Autonomous Systems and Technology CTA:** Perform enabling research and transition technology that will enhance warfighter's tactical situational awareness in urban and complex terrain by enabling the autonomous operation of a collaborative ensemble of multifunctional, mobile microsystems.

- **Robotics Collaborative Technology Alliance CTA:** Enable the creation of future highly autonomous unmanned systems and permit those systems to effectively conduct military operations in mixed environments.

- **Network Science CTA:** Bring together government, industry and institutions of higher education to perform foundational, cross-cutting research for a fundamental understanding of interactions, interdependencies, and common underlying science among multi-genre (social/cognitive, information, and communications) networks. Prediction and control of the composite behavior of these complex interacting networks will ultimately enhance effectiveness of Army systems and operations.

- **Cognition and Neuroergonomics CTA:** Conduct research and development leading to the demonstration of fundamental translational principles of the application of neuroscience-based research and theory to complex operational settings. These principles will guide the development of technologies that work in harmony with the capabilities and limitations of the human nervous system.

A full listing of related ARL CTA/CRA programs can be found on the ARL website:

https://www.arl.army.mil/www/default.cfm?page=93

3. CRA Programmatic Strategy

The CRA is intended to foster collaborative basic research (Budget Activity 1-see definition below) involving the Consortium and the Government. ARL's strategy is to continue exploiting research capability and expertise where it exists through the issuance of a single award under this PA to a Consortium of organizations that may include institutions of higher education, industrial and non-profits entities. ARL and the Consortium, selected for award, will establish an Alliance to address research topics critical to DCIST and will work in collaboration to advance distributed and collaborative intelligent systems research of relevance to the Army. Additionally, other government agencies may participate in the CRA and contribute their technical expertise, personnel and facilities. A significant goal of this effort will be to create a critical mass of scientists and engineers focused on solving the research challenges outlined within the scope of the CRA. This intellectual synergy is also expected to include sharing equipment, personnel and facilities to promote efficiency and collaboration.

Based upon the research topics discussed in Section II.A.4 and the resources identified in Section II.A.7, the research and collaboration strategy developed by the Applicant should adopt a systematic approach to fundamental research focused on understanding the principles necessary to achieve the DCIST vision. Applicants must carefully choose research topics to ensure a critical mass of researchers addressing the challenges proposed. Applicants are expected to apply sufficient resources to each of the three Research Areas: Distributed Intelligence, Heterogeneous Group Control, and Adaptive and Resilient Behaviors to enable fundamental advances in research in each of the three Research Areas.

It is the intent of this PA 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 PA seeks Whitepapers and proposals from those who receive a subsequent invitation, which will result in the award of a single CA. In response to the PA, an Applicant will be required to:

- Define the strategy for implementing an approach which synergistically integrates the three RAs, and outlines the metrics by which success of the Consortium is expected to be measured.

- Scope and define the research, appropriate to the overall funding of the CRA, ensuring all elements of the proposed research are tightly integrated in a way that

results of research in one RA support and enhance the results in the other two RAs. An Applicant should identify the most critical research issues and describe how the set of research efforts meet the goals of this program. Sufficient resources should be allocated to ensure enough critical mass to make fundamental progress.

- Formulate a basic research program which clearly demonstrates innovative, detailed and substantive scientific plans to address each of the three RAs as discussed in Section II.A.4. Clearly articulate the Applicant's vision for CRA and the Applicant's research goals for the program (two, five and ten year goals).

- Present the experience, qualifications and availability of the scientific staff and the quality and relevance of research facilities.

- Identify approaches to building collaborations within the Consortium and with ARL, which are essential to the success of the CRA and to jointly seek out and engage in high priority research, integration of new partners, and redistribution of funding as needed to maintain an innovative and impactful research vision and program.

- Identify the overall management (business plan) and programmatic and administrative team with the expertise to achieve the stated research goals and to oversee and manage finances, reporting, data, meetings, tracking and repository of program metrics, reviews and intellectual property.

Providing the requirements above will furnish the structure for the desired comprehensive and cohesive outcome of the basic research performed under the CRA. The core basic research program will be initially funded under Budget Activity 1 (basic research) funding. However, the CRA will also allow participation from other Government agencies and may result in additional Budget Activity 1 (basic research) funding as well as Budget Activity 2 (applied research) funding (**see discussion of Enhanced Program below**). Therefore, the research proposed and performed must comply with the definition for Budget Activity 1 or Budget Activity 2 funding (as appropriate) as outlined in the DoD Financial Management Regulation (FMR), Volume 2B, Chapter 5 (December 2016) as follows:

- **Budget Activity 1: Basic Research.** Basic research is systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. It includes all scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It is farsighted high payoff research that provides the basis for technological progress. Basic research may lead to: (a) subsequent applied research and advanced technology developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation,

energy conversion, materials and structures, and personnel support. Program elements in this category involve pre-Milestone A efforts.

- **Budget Activity 2: Applied Research**. Applied research is systematic study to understand the means to meet a recognized and specific need. It is a systematic expansion and application of knowledge to develop useful materials, devices, and systems or methods. It may be oriented, ultimately, toward the design, development, and improvement of prototypes and new processes to meet general mission area requirements. Applied research may translate promising basic research into solutions for broadly defined military needs, short of system development. This type of effort may vary from systematic mission-directed research beyond that in Budget Activity 1 to sophisticated breadboard hardware, study, programming and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. It includes studies, investigations, and non-system specific technology efforts. The dominant characteristic is that applied research is directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters. Applied Research precedes system specific technology investigations or development. Program control of the Applied Research program element is normally exercised by general level of effort. Program elements in this category involve pre-Milestone B efforts, also known as Concept and Technology Development phase tasks, such as concept exploration efforts and paper studies of alternative concepts for meeting a mission need.

4. CRA Research Strategy

a. Research Areas:

The overall objective of the DCIST CRA is to develop the underpinning science to enable highly heterogeneous, distributed, and collaborative intelligent systems and Soldiers. To achieve this, ARL has identified three interrelated aspects or RAs of DCIST, that when jointly and interactively studied should advance the theoretical foundations of DCIST in the context of Army relevant scenarios.

The DCIST CRA is seeking Proposals that address three key RAs in:

RA1: Distributed Intelligence
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Distributed Intelligence, Heterogeneous Group Control, and Adaptive and Resilient Behaviors are intricately linked and must be studied jointly. The proposed research must develop appropriate mathematical representations, metrics, models, experiments, and analysis techniques. This will lay the foundation for future systems that are expected to extend reach, situational awareness, and operational effectiveness against dynamic threats

in complex and contested environments and technical and operational superiority through intelligent, resilient and collaborative behaviors.

RA1: Distributed Intelligence: *Establish the theoretical foundations of multi-faceted distributed networked intelligent systems combining autonomous agents, sensors, tactical super-computing, knowledge bases in the tactical cloud, and human experts to acquire and apply knowledge to affect and inform decisions of the collective team.* The incorporation of these agents, technologies, and humans is key, but not well understood; it is therefore important to address their combination and interaction in a dynamic setting. New theories of distributed awareness, learning, and intelligence are needed. For example, to develop a fundamental science of cognitive programs that are distributed and adaptive and whose architecture might be influenced by cognitive neuroscience or graph signal processing. Such cognitive programs might couple networking, the value of information, estimation, and control.

Distributed Awareness is the ability of distributed systems to perceive the environment and gather information from many different sources to provide situational awareness, or knowledge, for the individual platform as well as the collective system. How and what information to share given potential and varying bandwidth constraints, how to represent this collective model of the world across heterogeneous systems, or even how to characterize the limits of distributed knowledge acquisition with varying levels of processing power, memory, intelligence, or ability to act on the information are not well understood.

Distributed learning is a fundamental aspect of distributed intelligence. It is desired to go well beyond the current big-data deep learning state-of-the-art and might include aspects such as modular multi-component architectures, fast and slow learning, incorporation of prior knowledge, learning and knowledge bases, or learning and human expert interaction.

Distributed Intelligence means that the individual and collective system can reason about the constantly changing local and collective situational awareness and the local and overall mission objectives to make predictions about the future and perform real-time adaptations and decisions to optimize operations based on that future. A key element of future military intelligent systems is that they must make decisions, likely at speeds beyond human capacity. A distributed collective of agents should make group decisions that are acceptable based on the cost/benefit preferences of the mission commander, yet we are far from a satisfactory means to achieve this reliably today. Foundations and methods need to be devised to provide distributed control and decision making that is responsive to human intent, interactive to changes in that intent, and function in complex environments with high degrees of uncertainty.

Human interaction is fundamental to distributed intelligence. The ability to couple human awareness with traditional control and estimation theory is not well understood and may lead to multiple, potentially non-traditional, future roles for humans in distributed intelligence. In addition, methods to jointly (human/intelligent system) reason and make decisions are also not well understood, especially when considered over varying latencies

to include cases where system response is required at a pace that is far beyond what can be achieved via human interaction, or when there are significant disparities in the quantity and quality of information available to the collective system relative to the human. New theories of human interaction in distributed intelligent systems are needed such as: the science of autonomy querying humans; coupling system intelligence and human supervision (e.g., human as system coach); enhanced awareness and decision making through the coupling of humans and intelligent systems; or adapting to the axes of complexity via human interaction.

The ability to draw on knowledge bases, high performance computational resources, real time modeling and simulations, and human experts provides new avenues for research across domains including engineering and computer science. Their integration with autonomous agents may lead to new approaches to, for example, distributed perception, real-time joint decision making, and reasoning with uncertainty. While knowledge bases provide rapid answers to queries, they are associative and rely on similarity, and typically provide many possible answers, some of which may be dramatically incorrect. Thus, mechanisms are needed for interactive querying and information push and pull. Even more fundamentally, a science and analytical framework is needed to bridge control and signal processing on the one hand, and associative knowledge bases on the other

It is expected that RA1 will draw on and link with techniques developed in RA2 (Heterogeneous Group Control), and feed RA3 (Adaptive and Resilient Behaviors), and that RA1 will create a synergistic set of collaborative projects that over the lifetime of the CRA will lead to a fundamental science of distributed intelligence.

RA2: Heterogeneous Group Control: *Develop theory and algorithms for control of large autonomous teams with varying levels of heterogeneity and modularity across sensing, computing, platforms, and degree of autonomy.* There are many open questions for future Army systems as to the optimal degree and mix of homo- and heterogeneity (e.g. sensing, computation, platforms, levels of autonomy, multiple roles for individual platforms and agents, and human/robot teams) to balance design complexity, modularity, and broad applicability and adaptability of the overall system. Envisioned future Army intelligent systems may have small to large teams of agents, and perhaps multiple swarms of agents, moving at varying speeds up to ballistic rates.

There is no general framework or design for distributed heterogeneous teams. A science of heterogeneous group control is needed that subsumes local (decentralized) to global (centralized) control. More research is needed in new sophisticated hybrid control architectures for large heterogeneous teams that may include both global and localized control, alternative approaches to heterogeneous group control, methods for spatially and temporally distributed small and large teams, emergent behaviors, and localized swarm behavior. Architectures and abstractions may be key to developing a successful theory that leads directly to algorithms and implementations.

Group control should integrate tactical networking and be resilient to network performance variation. It is desired to go well beyond the state-of-the-art such as slowly converging

consensus methods, and develop optimal designs that integrate network control and autonomous agents.

Heterogeneous (physical and virtual) agents may scale in various ways including size (e.g., small UAS and UGV autonomous agents to large air and ground vehicles), computation (e.g., up to high performance computing), and networking (e.g., simple low power radios to sophisticated cognitive architectures). Thus it is important to understand a range of scales and capability in the context of the axes of complexity described in Section II.A.1, with integrated power and energy resource awareness and management.

In challenging Army tactical scenarios, learning may play a key role in dealing with unknown environments. For example, this may couple with RA1 approaches to distributed intelligence that integrate multi-agent learning.

Heterogeneous group control exists in the CRA context of distributed collaborative intelligence, which includes human interaction. Fundamental science is needed to incorporate humans in the context of group control which might include, for example, supervision and interaction over different time scales. Similarly, research topics might include real-time planning and re-planning, teaming and re-teaming, and adaptive tasking, in relevant tactical scenarios over a wide range of operational tempos.

It is expected that RA2 will have a rich interaction with RA1 (Distributed Intelligence) and enable new approaches in RA3 (Adaptive and Resilient Behaviors) that merge cognition and control.

RA3: Adaptive and Resilient Behaviors: *Develop theory and methods for heterogeneous teams to carry out tasks under dynamic and varying conditions in the physical world.* Approaches are needed that merge cognition and control, with an emphasis on real-time tactical operations, to explore adaptable group behaviors (e.g., human interaction, teaming, and learning) in the face of changing situational awareness and the axes of complexity leading to desired behaviors such as: coordinated rapid multi-agent maneuver in complex environments; swarm release and control for threat identification and engagement; response to adversary intelligent systems and swarms; response to electronic attack; persistent surveillance for extended time periods; mobile (and stationary) sensor deployment; mobile soldier services such as network healing, threat sensing, and decision making, and adaptive mission planning. Coupling with RA2, it is desired to develop resilient approaches, e.g., that are robust to networking and information uncertainty, or that incorporate tradeoffs in networking, mobility, and power and energy.

Adaptive mission planning is needed when faced with difficult operational conditions, e.g., incorporating rapid learning and behavior synthesis, or enabling rapid reconfiguration and control. This problem grows combinatorically with large heterogeneous multi-agent systems, where planning must be coordinated across many heterogeneous sub-systems with varying mission objectives, where individual agents may or may not have the same goals, where some agents may not be able to complete their tasks due to failures, and there exist non-cooperative players or adversaries. Agents may be reconfigured, and new agents

introduced. Research is needed in sub-optimal planning and exploration of the tradeoffs in speed of planning versus the accuracy and optimality of the plan. The ability to rapidly learn and generate new behaviors on-line are likely critical to deal with contingencies and for the system to exhibit resilient behavior. On-line behavior synthesis is a challenging problem even when using a central architecture.

Resilience is critical for intelligent systems yet very difficult to model, analyze, and put into practice. Resiliency of large multi-agent Army systems needs to be considered based on realistic network performance, and uncertainties in localization, mapping, sensing, and the state and abilities of other agents. Morphing, reconfigurable, and adaptable platforms and systems performance are ways to offer increased resiliency. Approaches are needed that leverage heterogeneity and mechanical adaptability for enhanced system resilience.

It is expected that RA3 will have a significant experimental component, including data collection that might support RA1 and RA2 (see comments under "Cross-Disciplinary Experimentation" below). It is also expected that RA3 will have strong links with RA1 and RA2, identifying key issues that might be addressed in RA1 and RA2, and drawing on these areas over the life of the CTA.

b. Underlying Research Themes

Several research themes are common across the RAs, including learning, networking, and experimentation. The CRA vision is that a joint collaborative approach by a multidisciplinary research team is required to make fundamental advances towards meeting the CRA goal to develop a fundamental understanding of highly distributed and collaborative Intelligent Systems, and that collaboration between the Consortium and the Government is also integral to the execution and success of the CRA. Thus it is important to consider these underlying themes across the entire program, and to consider projects that span or feed into more than one RA. While ARL regards these three underlying themes to be of high importance, this should not be considered an exhaustive list and other underlying themes should be described and explored as appropriate.

Learning: Learning is a key element of future distributed intelligent systems, impacting all three RAs, and it is expected that some common elements will emerge that could lead to cross-area projects. Recent progression in artificial intelligence (AI) and machine learning has led to a large number of advances in various applications, many of which overlap with the research areas in this CRA. As noted in the RA1 description, it is desired to go well beyond the current big-data deep learning state-of-the-art. Addressing learning in the distributed collaborative intelligence setting raises many new research questions and opportunities, such as: multiple cooperative learners, incorporating knowledge bases, accelerated learning with operationally relevant data sets, modularization and canonical processing components, incorporating prior knowledge, ability to adapt with changing input distributions or domains, and real-time experimentation with ability to characterize performance.

Autonomous Networking: Army networked systems must operate in challenging environments, with little or no infrastructure, and with power and energy constraints. Thus

there is an intimate coupling between networking, control, autonomy, and distributed intelligence. It is a fundamental goal to blend networking and autonomy to enhance both and provide resilient seamless services. Addressing autonomous networking in the distributed collaborative intelligence setting should account for wireless networking instabilities, time variation, bandwidth, and adversarial disruptions while blending cognitive networking and collaborative intelligence. Future Army networks will be increasingly adaptive, intelligent, and responsive to the operating environment; the interplay with distributed intelligent systems may be critical to achieve the DCIST vision.

Cross-Disciplinary Experimentation: It is expected that joint cross-disciplinary experimentation will be an integral part of the CRA basic research program to explore and discover the interdependencies across the research areas. Experiments might incorporate autonomous physical agents, networked human experts, real-time distributed high performance computing, collection of large data sets to be shared across research areas (e.g., for project to address learning), and other elements. As the research matures it is desired to carry out complex large scale heterogeneous experimentation with autonomous agents, which may require indoor/outdoor site(s), e.g., to accommodate swarms, rapid deployment or high operational tempo cases.

5. Collaboration

a. Background

This program continues the ARL concept of creating Alliances CTAs and CRAs to facilitate a close collaborative relationship between ARL and its partners. Experience has shown that persistent collaboration across the Alliance enhances innovation and has a high return on investment. Therefore, collaboration between Consortium and Government researchers is integral to the execution and success of the CRA. Creation of an environment that is conducive to collaboration is therefore a critical element in establishing the Alliance. This section describes collaborative opportunities and potential avenues to collaborate under the DCIST CRA. The implementation of the collaboration with ARL will be through the proposed Initial Program Plan (IPP) and the subsequent Biennial Program Plan (BPP). Applicants are invited to suggest additional new and innovative avenues for fostering collaboration among Alliance partners.

b . Collaboration Opportunities

ARL will fund in-house staff and align in-house research to foster highly collaborative partnerships between Consortium and Government researchers. This in-house effort is anticipated to cover all three RAs of the DCIST CRA. ARL will shape its mission program for synergies with the CRA research strategy, the CRA Initial Program Plan (IPP) and subsequent Biennial Program Plans (BPPs), thus ensuring a direct and continuing collaboration across the Alliance. The BPP will be the basis for the Alliance to optimize the collaboration, information, research and technology transfer between the CRA and ARL. The Government may also leverage and/or integrate other interested Other Government Agencies (OGAs) (and funding where appropriate) into the CRA umbrella.

c. Staff Rotation

An important element of CRA collaboration is the advancement, education and rotation of research staff through short-term and long-term temporary assignments. The scope of this collaboration may range from regular, periodic short term visits to sabbaticals lasting as long as a year. Staff rotations will be undertaken to foster and facilitate collaborative research where face-to-face interaction is advantageous, to enable a researcher to utilize unique facilities, to enable Alliance personnel to obtain specialized training or experience and to facilitate the exchange of research results. In addition, this exchange, or cross fertilization, of personnel will provide Consortium personnel with insight into Army unique requirements and will provide Government personnel with insight into state-of-the-art research and commercial practices and/or the opportunity to pursue fundamental research with noted researchers. The success of these interactive and collaborative exchanges will be assessed by the quality of the collaboration as demonstrated by joint efforts such as basic research transitions to applied research programs, archival journal papers, patents, and refereed presentations. Applicants should outline the range of opportunities foreseen for collaboration and the mechanisms that will be put into place to foster staff rotations and other collaborative activities. Given the collaborative nature of the program, significant staff rotations, of both short and long-term durations, amongst the Alliance are expected, including a Consortium presence located at an ARL site.

All salary and travel costs associated with the rotation of Government personnel will be borne by the Government. All salary and travel costs associated with staff rotations of Consortium members will be funded under the CA or may be provided by the Consortium as cost-share. There should be a balance of staff rotations across all the partners in the Consortium and across all the research areas. It is anticipated that some portion of the Consortium's scientific labor-years will be in staff rotations. Space will be available at ARL to host Consortium leadership and researchers and likewise the Consortium is expected to create collaborative spaces to host other Consortium members and ARL staff.

d. Lectures, Workshops, and Research Reviews

The Alliance (Consortium and ARL) will be encouraged to hold, from time to time throughout the period of performance of the DCIST CRA, scientific lectures, short courses and workshops on mutually agreed upon topics. These lectures and workshops will serve as both educational and research outreach opportunities and should involve participants outside the Alliance when appropriate. Additionally, the Alliance is expected to hold an annual technical research review that will permit the free exchange of ideas and research results and serve as input into the BPP planning process. The Consortium will also support planned Research Management Board (RMB) reviews in years one, three, and five of the program to support the BPP planning process and smaller reviews for ARL and Army leadership on off years. If the five year extension is granted, RMBs will be held in years six and eight as well. If the five year extension is granted, a Capstone event will be held at the conclusion of the program. The costs associated with the Consortium's efforts

for these lectures, short courses, workshops and reviews will be funded under the CA.

The Consortium is also expected to host a web based repository of information from the CRA that is accessible by ARL, Consortium members, and CRA stakeholders for the duration of the CRA. At completion of the CRA, documentation will be delivered to the government for record keeping. This repository will include programmatic and review material. It will also serve as a vehicle for software and dataset sharing..

6. Management

a. Background

It is critical the Consortium be structured and managed to create and foster an open, collaborative research environment. This section describes a lightweight framework for the organization of the CRA. The lightweight framework is flexible to minimize overhead, yet insure research relevance and proper oversight. Applicants can suggest additional management tools and mechanisms as part of the Proposal, but in doing so they must justify and demonstrate the benefit and cost effectiveness of these additional management activities.

b. Overall Management Concept

ARL and the Consortium will establish a Collaborative Research Alliance. Additionally, other Government agencies may be invited to join this Alliance and to contribute, as appropriate, their technical expertise, personnel, access to research facilities and funding. The Alliance will strive for a focused, yet flexible research environment. To accomplish this, the consortium should consist of a small number of institutions of higher education, and industrial organizations, including the Lead Research Organization (LRO), possessing significant expertise in one or more of the Research Areas covered by the CRA, led by a single organization, the LRO, with the ability to integrate the broad palette of research required to realize the goals of the CRA. Each RA will be led by a different Lead Research Area Organization (LRAO), one of which could also be the LRO. Together the LRO and LRAOs make up the Consortium, who together are responsible for shaping and steering the CRA through participation, with their respective ARL Research Area Leads. Performance under the CA may also include other organizations as subawardees to round out the technical expertise and research tasks in a given RA. Any such organizations are expected to be subawardees to the LRO.

In addition to research conducted by members of the consortium, the research program may be enhanced by research undertaken by other organizations selected jointly by the Alliance as part of its planning process. Applicants are asked to suggest a process for incorporating new topics and organizations into the research program.

c. Technical Guidance and Oversight

The following framework is required for the management and oversight of the Alliance. It consists of parallel managers from the Government and the Consortium who will provide

day-to-day coordination and management of the program. Applicants may propose additional plans or mechanisms for management; however, Applicants are cautioned to ensure that any such plans or mechanisms are: (1) not duplicative of the requirements, and (2) not overly burdensome to the Alliance. A description of each component of the Alliance Management follows:

- The **Lead Research Organization (LRO)** is expected to provide research leadership, create and foster deep and persistent multidisciplinary research, perform administrative duties, and conduct fundamental research in DCIST. This includes participating in the research, promoting research to technology, distributing Government funding to Consortium Members and subawardees in accordance with the approved IPP/BPP under the agreement, and maintaining proper research invoicing.

- **Program Manager (PM).** The CRA Program Manager (PM) is the Consortium's scientific representative charged with the Consortium's overall responsibility for management and guidance of the CA. The PM will be designated by the LRO and must be a member of that organization. Management of the CRA is expected to be the primary responsibility of the individual assigned as PM and a commitment of time commensurate with this responsibility is also required. The PM is required to be an eminent scholar in the field of DCIST and have the stature, experience and leadership skills to successfully execute the CRA program. It is recognized the PM may require staff support to manage and execute the CA, and this staff support should be included in the Proposal. The PM will serve, in collaboration with the CAM, as a member and provide leadership for the TMG.

- **A Lead Research Area Organization (LRAO)** is expected to provide research leadership for a specific Research Area of the CRA, create and foster deep and persistent multidisciplinary research, perform administrative duties, and conduct fundamental research in DCIST.

- **Research Area Lead (RAL):** Each LRAO will identify a specific Principal Investigator to represent the LRAO in CRA planning and execution and to serve as a member of the TMG.

- **Collaborative Alliance Manager (CAM)**. The research executed under the CRA will be considered an extension and integral part of the U.S. Army Research Laboratory (ARL) research program. As such, the program established under this PA will be planned, defended, executed, and reviewed as part of ARL's mission program. Overall scientific management and fiscal responsibility for the CRA will reside with a senior ARL scientific manager, who will be designated the CAM for the CRA under the CA. The ARL Grants Officer will receive recommendations from the CAM and will be the ultimate legal authority empowered to make formal adjustments to the CA.

- **DCIST Chief Scientist.** The research executed under the CRA will be considered an extension and integral part of the U.S. ARL research program. As such, the

program established under this PA will be planned, defended, executed, and reviewed as part of ARL's mission program. The DCIST Chief Scientist (Government scientist) will assist the CAM with the overall scientific management of the CRA, working with the TMG to continuously shape the strategic direction and an innovative and scientific approach for the program.

- A **Technical Management Group (TMG**) is chaired by the CAM and consists of the PM, the three RALs, as well as the corresponding three RA Government technical leads and the DCIST Chief Scientist. The RALs and their respective Government RA leads will collaboratively lead the RAs through the TMG. The TMG will assist the CAM and the PM in carrying out their duties concerning the DCIST CRA. The TMG will be responsible for the management and integration of the Alliance's efforts under the CRA including programmatic, technical, reporting, financial, and administrative matters.

- A **Research Management Board (RMB)** will be established by ARL to identify and develop collaborative opportunities, advise and assist the CAM in setting research goals, provide advice into the BPP planning process, provide recommendations to the CAM for the decision for a CRA 5-year extension, and facilitate transition of CRA research to ARL basic and applied research programs. The RMB will be chaired by the CAM and will include representatives from Army, other service organizations and other government agencies with interest, expertise in the technologies related to the CRA. The RMB will be invited to CRA meetings, and be informed about the Biennial Program Plan approval process.

d. Articles of Collaboration (AoC)

The Articles of Collaboration define the operational structure and governance within the Consortium including:

- Membership and management
- Changes to Consortium membership
- Financial, personnel, facilities, and reporting requirements
- Intellectual property
- Information exchange guidelines
- Modifications to the Articles of Collaboration (AoC)

An Applicant invited to submit a Proposal will be provided a model AoC with their invitation to submit a Proposal. The model AoC represents appropriate and necessary terms and conditions that the Government finds acceptable for operation of the Consortium. An Applicant must submit the AoC with the Proposal signed by a duly authorized representative for each proposed Member of the Consortium. The model AoC can be executed by the proposed Members of the Consortium "as is" or changes to the AOC can be proposed. If changes are proposed, an Applicant is hereby informed that justification

of any changes should be included with the Proposal and such changes must be acceptable to the Government for the Applicant to be eligible for award.

e. Initial Program Plan (IPP) and Biennial Program Plan (BPP).

Within 90 days after award, the Alliance (through the TMG) will jointly prepare an Initial Program Plan (IPP) to cover the first 12 months of performance. The IPP will be based substantially on the Proposal received from the Consortium. The IPP will be accompanied by a five-year vision that describes the overall plan to be accomplished by the Consortium within the Alliance structure. The vision should provide a detailed description of a well-coordinated preliminary IPP for execution of the basic research. It should provide approximate timelines for research activities to facilitate potential future basic research transitions.

Eight months after award, the Alliance (through the TMG) will jointly prepare a proposed Biennial Program Plan (BPP) scoped to cover in detail the next two fiscal years. Through discussion among the Consortium members, a BPP will result that enables integration and execution of multidisciplinary, collaborative research that strives to achieve CRA objectives. The CAM will approve the BPP and formally submit the approved BPP to the Grants Officer for incorporation into the CA. This process will continue through the life of the CA.

Each BPP will cover a two-year timeframe, but may be altered, with the approval of the CAM and the Grants Officer, if research work requirements change. The BPP will provide a detailed plan of research activities (including research goals, key personnel, staff rotation, facilities, experiments and budget) that commits the Consortium to use their best efforts to meet specific research objectives. The BPP will also describe the collaborative efforts with the Government. The BPP will include a detailed description of the projects proposed to be undertaken by any subawardees.

During the course of performance, if it appears that research goals will not be met, the TMG will provide a proposed adjustment to the BPP for approval by the CAM. In addition, the CAM may from time to time request that additional research be added to the BPP within the scope of the CA. The Consortium, as an entity, will not solicit or accept funding from outside sources other than ARL without the approval of the CAM and the Grants Officer.

During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the IPP/BPP including but not limited to:

- Changes in the scope or the objective of the program, IPP/BPP, or research milestones;
- Change in the key personnel specified in the IPP/BPP;
- The absence for more than three months, or a 25% reduction in time devoted to the project, by the PM;

- The need for additional Federal funding; and
- Any subaward, transfer, or contracting out of substantive program performance under an award, unless described in the IPP/BPP.

The CAM, in coordination with the TMG, will be responsible for integrating the IPP/BPP into the respective overall research and technology programs. During the course of performance, the Grants Officer, in coordination with the CAM, will have approval authority for certain specific changes to the CA including, but not limited to:

- Changes to the Articles of Collaboration if such changes substantially alter the relationship of the parties as originally agreed upon;
- Solicitation or acceptance of funding under the agreement from sources other than ARL; and
- Changes in Consortium membership.

f. Collaboration and Technical Review Meeting

Each year, the Alliance must organize a CRA Collaboration and Technical Review meeting where Alliance researchers engage in face-to-face technical discussions. The overall goal of this meeting is a technical review of the CRA for ARL, ARL stakeholders, Army leadership, and Consortium leadership to provide input into the BPP planning process. It is also intended to foster interactions and collaborations among researchers. The emphasis is on collaborations (especially multi-disciplinary, cross-Research Area collaborations), experimentation/validation plans, and possible transition opportunities. Planning for the Collaboration and Technical Review Meeting will be executed through the PM and the CAM. Additionally, it is anticipated the Alliance will participate in other ARL/Army program reviews.

g. A **Research Management Board (RMB)**

An RMB will be established by ARL to identify and develop collaborative opportunities, advise and assist the CAM in setting research goals, and facilitate transition to development programs. The RMB will include representatives from Army and other service organizations and other government agencies with interest and expertise the DCIST CRA. The RMB will be invited to the Collaboration and Technical Review, conduct a review of the proposed IPP and BPPs in years one, three, six and eight, and provide advice to the CAM and ARL on the recommendation for the 5-year option of the CRA in year five.

g. Evaluation for Five-Year Extension

The CRA will be awarded for a five-year period. There will be an option to extend the CRA for an additional five years. After the fourth year, a comprehensive program review will be conducted as directed by ARL and the RMB. This review will consider cumulative performance metrics, the Consortium's vision for the additional five-year period of performance (to be submitted by the Consortium at the end of the fourth year), funding

availability and the current research needs and goals of the US Army. Performance metrics are expected to include items that provide an indication of the CRA's accomplishments such as the number of refereed journal and conference articles, invited presentations, patents, relevance of the work to ARL, collaboration, and staff rotation. The decision as to whether to exercise the option is expected to be based on the results of the review and evaluation described above.

h. Distribution of Funding

The LRO will distribute the funding to all Consortium Members and subawardees.

7. Funding

The estimated funding levels for the CRA over the projected period of performance, including options years, is shown in the top part of Table 1. The funding includes all known costs associated with the CA, i.e. the costs for research, program management, experimentation, travel, etc. Proposed guidance for unfunded Enhanced Program funding is also depicted in the bottom part of Table 1.

Award will be made to the Consortium that offers the best value to the Government. An Applicant must recognize and understand there are no guarantees associated with the levels of funding during the period of performance. Consortium Members may be expected to compromise and sacrifice anticipated funding to their organization as necessary and appropriate to meet the goals and objectives of the CRA as established through the collaborative planning process.

Enhanced Research Program

Should additional funding for the DCIST CRA become available from OGAs, an Enhanced Research Program Funding provision is included in this PA will be included in the resulting CA. This provides a mechanism for growth and enhancement within the CRA. ARL, the Army and OGAs may choose to support the program with basic and/or applied research dollars in areas of specific interest to their basic and applied mission programs. This Enhanced Research Program will leverage and/or transition the research, technology and capabilities from the Core CRA Research Program. **In response to this PA, Applicants are NOT to include any discussion of the Enhanced Research Program in the Whitepaper. While an Applicant invited to submit a Proposal is required to provide detailed information to address the entire funded Core CRA Research Program, Applicants are asked only to provide a general discussion of possible additional research that could be pursued should funding be received for the Enhanced Research Program.**

Table 1. Anticipated CRA Funding
(Funded Core CRA Research Program & Unfunded Enhanced Research Program)

	Core Research Program ($M)

Funding Category	Fiscal Year										
	FY18 *	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	**Total (10yr)**
Basic Research (6.1)	3.6	5.8	5.9	6.1	6.2	6.3	6.3	6.3	6.2	5.8	**58.5**
Core Total	3.6	5.8	5.9	6.1	6.2	6.3	6.3	6.3	6.2	5.8	**58.5**
	Enhanced Research Program ($M)										
Basic Research (6.1)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	**10.0**
Applied Research (6.2)	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.2	**20.7**
Enhanced Total	3.0	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.2	**30.7**
Total	6.6	8.8	8.9	9.1	9.3	9.4	9.4	9.4	9.3	9.0	**89.2**

Note: Total Funded 10 Year Core Program $58.5
Total Funded 10 Year Core and Unfunded Enhanced Program $89.2M

*The DCIST CRA is expected to be awarded in September 2017. Thus, a very small amount of FY17 funding may be provided to initiate the award. However, applicants should only use the funding levels listed in Table 1 above for cost proposal preparation.

B. AWARD INFORMATION:

One CA will be awarded as a result of this PA. The Applicant selected for award will be notified by the Grants Officer or his/her designee telephonically or via email. Upon notification, the selected Applicant will be required to sign the CA. The award is not official until each Consortium Member on the selected Applicant's Proposal has signed the CA and the Grants Officer has signed the CA.

A CA is a legal instrument which, consistent with 31 U.S.C. 6305, is used to enter into the same kind of relationship as a grant (see definition "grant"), except that substantial involvement is expected between the Federal Government and the recipient when carrying out the activity contemplated by the cooperative agreement. The term does not include "cooperative research and development agreements" as defined in 15 U.S.C. 3710a. No fee or profit is allowed.

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

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

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

FAR, DFARS, and AFARS: http://farsite.hill.af.mil/
Code of Federal Regulations: http://www.ecfr.gov

C. ELIGIBILITY INFORMATION:

1. Eligible Applicants

During performance, it is envisioned that there will be Consortium Members and Subawardees performing under the CA. The Consortium must be led by an institution of higher education. This organization will be designated as the LRO and this organization has specific leadership and management responsibilities and roles as outlined below. Each Research Area will be led by a different LRAO, one of which could also be the LRO. The same entity cannot be the LRAO for more than one Research Area. Together the LRO and LRAOs make up the Consortium. Consortium Members are expected to have significant involvement and input on a long-term basis as outlined below. Researchers from any Consortium Member may participate in the research undertaken within any of the three Research Area. It is anticipated that an optimally sized consortium, with subawardees, would include no more than eight organizations, but this should not be considered a hard limit. Whitepapers and Proposals that include more than eight organizations must provide

a rationale for the additional members. Thus, Applicants are expected to consider carefully the construct of their proposed Consortium and effectively engage the appropriate Membership and Subawardee performance to achieve the goals of the CRA. See also Section E.3 – Recipient Qualification.

Discussion of Consortium Members and other Participants in the CRA:

- **Lead Member called the Lead Research Organization (LRO)**:

  The LRO must be an institution of higher education. This institution is also expected to have doctoral level courses of study in scientific and research areas related to this CRA that can result in the granting of a doctoral degree. The LRO critical roles include administration of the CRA, promoting collaboration amongst the Consortium members and subawardees, and articulating the research leadership vision for the basic research program. The LRO is required to manage the Consortium, participate in the research, and promote the transition of research and technologies resulting from the research program within the CRA. The LRO required to distribute Government funding to Consortium Members and subawardees in accordance with the approved IPP/BPP under the CA. The LRO is responsible for timely billing (invoicing) of executed research for itself and the other Consortium Members to ensure proper disbursement of government funds.

- **Other Consortium Members – Lead Research Area Organizations (LRAOs):**

  Each LRAO may be an industrial, non-profit, or institution of higher education and must possess substantial experience and expertise in the research areas contained within the scope of the CRA. Each Research Area will be led by a different LRAO, one of which could also be the LRO. The same entity cannot be the LRAO for more than one Research Area. Under special considerations outlined below, Federally Funded Research and Development Centers (FFRDCs) may participate in the Consortium as a Member. Institutions of higher education are also expected to have doctoral level courses of study in scientific and research areas related to this CRA that can result in the granting of a doctoral degree. Industrial members are expected to have the ability to conduct appropriate research activities utilizing in-house engineers, scientists and facilities. All Consortium Members are expected to demonstrate opportunities for substantive collaboration with ARL, including appropriate opportunities for staff rotations and research collaboration. Researchers from a LRAO may participate in the research undertaken within any of the three Research Area.

- **Subawardees:**

  The Consortium may be augmented with subawardees to meet the research objectives of the CRA, especially for the conduct of new and innovative research for which they are particularly qualified.

- **Federally Funded Research and Development Centers (FFRDCs)**

  Federally Funded Research and Development Centers (FFRDC) may be included as Consortium Members (LRAOs) or subawardees in a Proposal under this PA, but an FFRDC may not be the LRO. FFRDCs may propose effort as allowed by their sponsoring agency and in accordance with their sponsoring agency policy.

2. Cost Sharing or Matching

Cost sharing is not required under this PA. See also Section I.B above.

D. APPLICATION AND SUBMISSION INFORMATION

The application process consists of a Whitepaper stage and a Proposal stage. The purpose of requesting Whitepapers is to minimize the effort associated with the production of detailed Proposals for those Applicants that have little chance of being selected for funding. The Government's decision to invite a Proposal will be based upon the evaluation of the Whitepaper submission. **An Applicant that does NOT receive an invitations from the Government to submit a Proposal is NOT eligible to submit a Proposal and will NOT receive any feedback or a "debriefing" on their Whitepaper.** An Applicant invited to submit a Proposal will receive feedback on their Whitepaper in order to improve their Proposal submission. An **Applicant that does NOT submit a Whitepaper, is NOT eligible to submit a Proposal for consideration for funding.**

1. Address to Request Application Package

This PA may be accessed from the following: Grants.gov (www.grants.gov)

Amendments, if any, to this PA 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 application process is in two stages as follows:

Whitepapers. Applicants are responsible for submitting electronic Whitepapers so as to be received at the Government site indicated in the PA no later than the date and

time specified in Section II.D.3. Whitepapers shall be emailed to Nikolaos.georgakopoulos.civ@mail.mil and must include a subject line of "WHITEPAPER –DCIST CRA" in order for the Whitepaper to be properly received. When sending electronic files, the Applicant shall account for potential delays in file transfer from the originator's computer server to the Government website/computer server. Applicants are encouraged to submit their Whitepaper early to avoid potential file transfer delays due to high demand or problems encountered in the course of the submission.

Acceptable evidence to establish the time of receipt at the Government site includes documentary and electronic evidence of receipt maintained by the agency. All submissions shall be emailed and received at the Government site before the cutoff time/date in order to be considered – NO exceptions.

If an emergency or unanticipated event interrupts normal Government processes so that Whitepapers cannot be received at the site designated for receipt by the date and time specified, then the date and time specified for receipt will be deemed to be extended to the same time of day specified in the PA on the first work day on which normal Government processes resume.

Whitepapers sent by any other means (e.g. submitted to other email addresses, hand-carried, postal service mail, commercial carrier or fax) will not be considered for evaluation. Applicants will receive an email confirmation that their Whitepaper has been received within 24 hours of receipt by the Government.

Proposals. UPON INVITATION ONLY, Proposals shall be submitted electronically through the www.grants.gov portal in Portable Document Format (.PDF). Proposals sent by fax or email will not be considered for evaluation. Proposals sent by organizations that have NOT been provided an invitation to do so will NOT be considered for evaluation. Applicants are responsible for submitting electronic Proposals so as to be received at the Government site indicated in the PA no later than the date and time specified in Section II.D.3.

Registration Requirements for www.grants.gov: There are several one-time actions that an Applicant must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the System for Award Management (SAM), register with the credential provider, and register with Grants.gov). See www.grants.gov/GetRegistered to begin this process. Use the Grants.gov Organization Registration Checklist at www.grants.gov/Applicants/get-registered.isp to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 21 calendar days to complete these requirements. It is suggested that the process be started as soon as possible.

Questions: Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov.

Whitepapers:

A Whitepaper should address:
The Whitepaper should focus on technical merit and innovation of proposed approaches to be pursued across all three RAs and include an overview of the research strategy and vision to be employed to advance the state-of-the-art in DCIST; a description and justification for near-, mid-, and far-term research goals of the proposed effort and their relevance to the Army and DoD; a technical discussion of the background and objectives of the overall proposed research focus within each RA, and parties involved; and the strategy for experimentation and validation of approaches developed in this CRA. The Whitepaper should clearly identify specific scientific challenges and research barriers that relate to fundamental understanding of the root cause of difficult DCIST problems. The Whitepaper should clearly highlight the innovations proposed, how they may lead to an understanding of DCIST phenomena and how the proposed research is expected to feed, be fed by, or in some other way link with, research being performed elsewhere within the Consortium.

The Whitepaper should include the names, brief biographies, and general availability of the key personnel who will be involved in the research. Such credentials, as documented on the biographical sketches, shall include, among others, a record of seminal publications in the scientific literature and a record of successful DCIST research.

The Whitepaper should include general information on previous collaborations and general plans for how researchers will collaborate across the three Research Areas and the Alliance and how this collaboration will further the goals of the program.

The Whitepaper should include the identification of the Program Manager, key leadership personnel and an overall plan for leadership and efficient management of the DCIST CRA and creation of a collaborative environment.

A Whitepaper shall be submitted in Adobe Portable Document Form (PDF) with the following Formatting:

- Page size when printed: 8 ½ x 11 inches
- Margins: 1 inch minimum
- Spacing and Page Numbers: At least single-spaced with numbered pages utilizing one side per page.

- Font: Times New Roman, no smaller than 10 point. Graphic presentations, including tables, while not subject to the same font size and spacing requirements, shall have spacing and text that is easily readable.
- Page Limits. Whitepapers shall not exceed the stipulated page limits. Pages in excess of the page limits will be removed and not evaluated.

A Whitepaper will consist of a:

- **Program Summary/Abstract:** The pages shall be numbered and **not exceed 2 pages**, utilizing one side of the page.
- R**esearch Program:** The pages shall be numbered and **not exceed 20 pages**, utilizing one side of the page.
- **Collaboration Plan and Program Management:** The pages shall be numbered and **shall not exceed 3 pages**, utilizing one side of the page.
- **Biographical Sketches**. Biographical sketches shall be limited to 1 page per individual, with no limit on the number of individuals.
- **Cost Summary Tables**. For the Whitepaper only, two cost estimate tables shall be provided to provide a broad idea of the Applicant's relative level-of-effort for the **Core Program funding only**. This information will be used in the evaluation of the research program. One table lists the estimated first year funding by organization for each RA (see Table 2). A column for Other can be used for management or other costs. Another table lists the estimated funding per organization for each of the five years (see Table 3).

Table 2. Year 1-5 Budget Estimates by Research Area ($K)

Organization	RA 1	RA 1	RA 3	Other	Total	Cost Share
Org A						
Org B						
Org C						
Org D						
Org E						
Org F						

Table 3. 5-Year Budget Estimates ($K)

Organization	Year 1	Year 2	Year 3	Year 4	Year 5	Total	Cost Share
Org A							
Org B							
Org C							
Org D							
Org E							
Org F							
Total							

Proposal:

A Proposal should address:
A Proposal should focus on technical merit and innovation of proposed approaches to be pursued and include an overview of the research strategy and vision to be employed to advance the state-of-the-art in DCIST; identify specific scientific challenges and research barriers that relate to fundamental understanding of the root cause of difficult DCIST problems; provide a description and justification for near-, mid-, and far-term research goals of the proposed effort and their relevance to the Army and DoD; provide a complete technical discussion of all proposed research stating the background, relevance, objectives, and provide ample evidence that the approaches are likely to substantially advance the underlying science; the parties involved and the level of effort to be employed (demonstrating that researchers are substantially and meaningfully engaged in the research efforts.); and provide a strategy for experimentation and validation of approaches developed in this CRA. A Proposal should clearly identify specific technical challenges that relate to fundamental understanding of the root cause of difficult military problems and should provide evidence that the proposed technical approaches can address these technical challenges. A Proposal should clearly highlight the innovations proposed and how they may lead to an understanding of DCIST phenomena and highlight how the proposed research is expected to feed, be fed by, or in some other way link with, research being performed elsewhere within the Consortium.

A Proposal should include the names, biographies, availability and proposed level of effort of the key personnel who will be involved in the research. Such credentials, as documented on the biographical sketches, shall include, among others, a record of seminal publications in the scientific literature and a record of successful DCIST research. A Proposal should include a description of the facilities to be used for the research and demonstrations, who will have access to these facilities, and how such facilities will enhance the research efforts proposed.

A Proposal should include plans for how researchers will collaborate within each Research Area and among Research Areas and describe how this collaboration will further the goals of the program. A Proposal should describe the strategy for collaborating with ARL and propose collaborative opportunities with ARL. A Proposal should include examples of how researchers have successfully collaborated previously in similar programs. A Proposal should also include the Applicant's plans and approach for enhanced research efforts should such funding become available during performance.

A Proposal should include a detailed plan for leadership and efficient management of the DCIST CRA, creation of a collaborative environment, and organizational structures. A Proposal should identify plans and ability for subcontracting, plans for distribution of funds and ability to track and meet DoD expenditure rates including

timely submission of consortium invoices, identifying and tracking program metrics, planned participation in the Technical Management Group and holding program and Research Management Board technical reviews, and overall research planning to include development, in collaboration with ARL, of the IPP and subsequent BPPs.

Proposal. 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 funding opportunity number, W911NF-17-S-0004. REMINDER: Only Proposals submitted by Applicants given an invitation to submit a Proposal will be eligible.

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 applies to the Proposal:

- Page size when printed: 8 ½ x 11 inches
- Margins: 1 inch minimum
- Spacing and Page Numbers: At least single-spaced with numbered pages utilizing one side per page.
- Font: Times New Roman, no smaller than 10 point. Graphic presentations, including tables, while not subject to the same font size and spacing requirements, shall have spacing and text that is easily readable.
- Page Limits. Proposals shall not exceed the stipulated page limits. Pages in excess of the page limits will be removed and not evaluated.

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.

- **Program Summary/Abstract** (Field 7 on the form) - The Program Summary should be a brief abstract `that summarizes the content of the Basic research of the Proposal. **The program summary must not exceed 5 pages.** Pages in excess of the page limit may be removed for the evaluation of the Proposal.
- **Program Narrative** (Field 8 on the form) - Chapters and Numbers of pages – Field 8 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 Proposal.

- **Chapter 1: Research Program**. The pages included in Chapter 1 shall be numbered. Applicants are advised that Chapter 1 **shall not exceed 50 pages**, utilizing one side of the page.
- **Chapter 2: Collaboration Plan**. The pages included in Chapter 2 shall be numbered. Applicants are advised that Chapter 2 of the Proposal **shall not exceed 10 pages**, utilizing one side of the page.
- **Chapter 3: Program Management**. The pages included in Chapter 3 shall be numbered. Applicants are advised that Chapter 3 of the Proposal **shall not exceed 10 pages**, utilizing one side of the page.
- **Chapter 4: Biographical Sketches.** Biographical sketches shall be limited to two (2) pages per individual, with no limitation on the number of individuals.
- **Bibliography and References 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 include a description of facilities and other resources available to support the Proposal. Attach this information at Field 10. Applicants are advised that this section **shall not exceed 5 pages**, utilizing one side of the page.
- **Equipment** (Field 11 on the form) - The Applicant is to include a description of equipment available to support the Proposal. Any Government equipment necessary for performance is to be clearly identified. Attach this information at Field 11. Applicants are advised that this section **shall not exceed 5 pages**, utilizing one side of the page.
- **Other Attachments** (Field 12 on the form) are as follows:
    1. Attached the completed Proposal Cover Sheet. (See Section D.6 below)
    2. Attached the completed certifications. (See Section F.2 below)
    3. Attach any exceptions or conditions to the Model Collaborative Agreement. (The Model Cooperative Agreement will be provided to Applicants who receive an invitation to submit a Proposal.)
    4. Attach the signed Articles of Collaboration for all Members. (A Model Articles of Collaboration will be provided to Applicants who receive an invitation to submit a Proposal.)

5. Attach the Cost Proposal. **The Cost Proposal must include 2 separate budgets for the first five years of performance: one for the Core Research Program and one for the Enhanced Research Program. The Cost Proposal for the Core Research Program MUST address all requirements for the Core Research Program. (The Consortium will be requested to provide a complete cost proposal for the optional five-year period of performance as part of the evaluation to be completed prior to making the decision concerning this optional period)** The cost portion of the Proposal shall contain cost estimates sufficiently detailed for meaningful evaluation. For budget purposes, assume a performance start date of 1 October 2018**.** The proposed amounts shall not exceed the funding ceilings identified for the Core Research Program and Enhanced Research Program of this PA. For all proposals, the elements of the budget should include:

- Direct Labor. Individual labor category or person, with associated labor hours and unburdened direct labor rates. 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 proposal 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 proposed research, management activities, divided between academic and non-academic (summer) terms, when applicable;

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

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

- Indirect Costs. Fringe benefits, overhead, G&A, etc. (must show base amount and rate). Justify.

- Costs Share. Amounts or percentages, expected benefits to the CRA as a result, and parameters institutional parameters for providing cost share.

- Travel. Number of trips, destination, duration, etc. Justify and include basis for costs. This should include anticipated travel between Consortium Member locations and ARL sites as well as conference attendance.

- Subaward. A Cost Proposal, as detailed as the Applicant's Cost Proposal, will be required to be submitted by each proposed subrecipient.

- Consultant. Provide consultant agreement or other document that verifies the proposed loaded daily/hourly rate. Include a description of the nature of and the need for any consultant's participation. Provide budget justification.

- Materials. Specifically itemized with costs or estimated costs. An explanation of any estimating factors, including their derivation and application, shall be provided. Include a brief description of the Applicant's procurement method to be used (competition, engineering estimate, market survey, etc.). Justify.

- Other Directs Costs. Particularly any proposed items of equipment or facilities. Equipment and facilities generally must be furnished by the recipient (justifications must be provided when Government funding for such items is sought). Include a brief description of the Applicant's procurement method to be used (competition, engineering estimate, market survey, etc.). Justify.

- Profit/Fee: Profit/fee is not allowed for the recipient or subrecipient 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.

- Cost of Money (COM): If cost of money is proposed, a completed Contract Facilities Capital Cost of Money (FCCM) (DD Form 1861) is required.

All entities included in the Cost Proposal are to provide detailed information on all cost elements included in their proposed budgets as part of the Proposal submission process. However, it is recognized that some entities may choose to submit their proprietary rate information directly to the Government in lieu of providing such information to the LRO for inclusion in the Cost Proposal submitted through grants.gov. In such a case, a separate submission can be made directly to the Government. Such a submission MUST include the PA Number, i.e. W911NF-17-S-0004, and the name of the LRO associated with the Proposal on the mailing envelope submitted to the following address:

U.S. Army Contracting Center – Aberdeen Proving Ground, RTP Division
ATTN: W911NF-17-S-0004
800 Park Office Drive, Suite 4229
Research Triangle Park, NC 27709

NOTE: All such separate submissions must arrive NLT than the due date and time specified in Section II.D.3 for the Proposal submission through grants.gov to be considered. Further, for all such submissions summary cost information must be provided to the LRO for the grants.gov submission that is sufficient in detail for the Government to use in the evaluation of the Cost Proposal for cost realism, and can be clearly mapped to the proprietary rate information submitted directly to the Government.

- **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 grant/collaborative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

3. Submission Dates and Times

Whitepapers are due by 3:00pm (local time in North Carolina, USA) on 28 April 2017. An email receipt from the Government will be provided to an Applicant for each Whitepaper submission received. A Whitepaper is not considered properly received until the Applicant receives this email from the Government.

Proposals are expected to be due in July 2017. (NOTE: A specific due date and time of submission, as well as any additional instructions, will be provided with the invitation to submit a Proposal. As a reminder, only the most highly rated Whitepapers will receive an invitation to submit a Proposal.)

After a proposal is submitted through Grants.gov, the Authorized Organization Representative (AOR) will receive a series of three emails. It is extremely important that the AOR watch for and save each of the e-mails. Applicants will know that the Proposal has been properly received when the AOR receives e-mail Number 3. The three emails are:

- Number 1. The AOR will receive a confirmation page upon completing the submission to Grants.gov and will receive a tracking number. This confirmation page is a record of the time and date stamp for the submission.
- Number 2. The AOR will receive an email indicating that the Proposal has been validated by Grants.gov within a few hours of submission. (This means that all of the required fields have been completed.)
- Number 3. The third notice is an acknowledgment of receipt in email from Grants.gov. The email is sent to the AOR for the institution. The email notes that the Proposal has been received**. THE PROPOSAL IS NOT CONSIDERED PROPERLY RECEIVED UNTIL THE AOR RECEIVES EMAIL #3.**

4. Intergovernmental Review - Not applicable

5. Funding Restrictions - See Section II.A above.

6. Other Submission Requirements

The following Proposal Cover Sheet is required to be submitted by each Applicant:

PROPOSAL COVER SHEET

1. Information concerning the LRO (points of contact (POC)):

Research POC: _____
Phone No.: _____
Fax No.: _____
Email Address _____

Business POC _____
Phone No.: _____
Fax No.: _____
Email Address: _____

2. List the names and relationships of all organizations included in the Proposal:

LRO _____
LRAOs – (Other Consortium Member(s)
_____
Subawardee(s) _____

3. Provide a point of contact for each organization included in the Cost Proposal. These individuals may be contacted for questions concerning the Cost Proposal:

Organization: _____
POC: _____
Phone No.: _____
Email Address _____

4. Signature of one person for the proposed LRO, and one person from each proposed LRAOs (Other Consortium Members), authorized to submit a Proposal and bind that organization: (These signatures may be provided on separate sheets.)

Organization Name: _____
Signature: _____
Type Name/Title: _____
Date (Proposal): _____

E. APPLICATION REVIEW INFORMATION

1. Proposal Evaluation Criteria

Whitepaper Evaluation Criteria. The following represents the evaluation criteria for this PA:

Factor 1: Scientific Merit and Relevance: Evaluation of this factor will concentrate on the overall scientific and technical merit, military relevance, and innovation of the proposed research in light of the DCIST state-of-the-art. This factor will be evaluated with regard to each of the three Research Areas of the CRA: Distributed Intelligence, Heterogeneous Group Control, and Adaptive and Resilient Behaviors. Each Research Area will be assessed with regard to its overall scientific merit, potential for technical innovation, research plan to achieve program objectives, strategy for experimentation and validation of approaches, and likelihood of substantially advancing the current state-of-the-art in DCIST science. Evaluation of this factor will also concentrate on the proposed balance of research across the three Research Areas, balance of near-, mid-, and far-term research focus, the overall long term relevance of the proposed research, and the likelihood that the proposed research will address the scientific challenges and research barriers facing the Army and the DoD.

Factor 2: Experience and Qualifications of Scientific Staff: Evaluation of this factor will focus on and assess the qualifications, capabilities, availability, proposed level of effort, accomplishments and past experience of the Applicant's proposed research personnel (individually and as a whole) as an indication of their ability to achieve the proposed technical objectives.

Factor 3: Collaboration and Program Management: Evaluation of this factor will focus on and assess the evidence of previous successful collaborative efforts, the Applicant's commitment and plans for an environment to foster collaboration across the Research Areas and with ARL, the approach to bring about a unity of vision for the Consortium, leadership ability of the Program Manager, identification and capability of key leadership personnel, and the overall plan for leadership and efficient management of the DCIST CRA.

Relative Importance of the Evaluation Factors: The evaluation factors are listed in descending order of importance with Factors 2 and 3 being approximately equal.

Proposal Evaluation Criteria. The following represents the evaluation criteria for this PA:

Factor 1: Scientific Merit and Relevance: Evaluation of this factor will concentrate on the overall scientific and technical merit, military relevance, and

innovation of the proposed research in light of the DCIST state-of-the-art. This factor will be evaluated with regard to each of the three Research Areas of the CRA (Distributed Intelligence, Heterogeneous Group Control, Adaptive and Resilient Behaviors). Each Research Area will be assessed with regard to its overall scientific merit, potential for technical innovation, research plan to achieve program objectives, strategy for experimentation and validation of approaches, and likelihood of substantially advancing the current state-of-the-art in DCIST science. Evaluation of this factor will also concentrate on the proposed balance of research across the three Research Areas and the near-, mid-, and far-term focus, the overall long term relevance of the proposed research, and the likelihood that the proposed research will address the scientific challenges and research barriers facing the Army and the DoD.

Factor 2: Experience and Qualifications of Scientific Staff and Quality of Research Facilities: The qualifications, capabilities, availability, proposed level of effort, and past experience of both the Applicant's proposed research personnel (individually and as a whole), and their ability to achieve the proposed technical objectives will be evaluated. 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 3: Collaboration: Evaluation of this factor will focus on the proposed collaboration plans for the CRA in accordance with the collaboration requirements set forth in the PA and the Articles of Collaboration. Evaluation of this factor will focus on, and assess, the evidence of previous successful collaborative efforts, the Applicant’s commitment and plans to foster real collaboration across the Research Areas and the Alliance, and the approach to bring about a unity of vision for the Consortium.

Factor 4: Program Management. Evaluation of this factor will focus on the leadership and plans provided by the Program Manager and Research Area Leads to meet the requirements of the overall management concept, plans and ability for subcontracting, plans for distribution of funds and ability to track and meet DoD expenditure rates including timely submission of consortium invoices, identifying and tracking program metrics, planned participation in the Technical Management Group and holding program and Research Management Board technical reviews, and overall research plan development to include development, in collaboration with ARL, of the Initial Program Plan and subsequent Bi-Annual Program Plans. Evaluation of this factor will include the adequacy of the overall management plan, internal team structures, and composition with respect to achieving the research goals of the program. The management plan will also be assessed with respect to approach and ability to include enhanced research efforts should such funding become available during performance.

Factor 5: Cost. While this factor will not be weighted, evaluation of this factor will consider cost realism, cost reasonableness, and affordability within funding constraints.

Relative Importance of the Evaluation Factors: The evaluation factors are listed in descending order of importance with Factor 5 not weighted.

2. Review and Selection Process

All timely and compliant Whitepaper submissions will be evaluated in accordance with the evaluation criteria set forth in this PA. Whitepapers are expected to be evaluated by a group of qualified scientists and managers from the Government. However, the Government reserves the right to have Whitepapers evaluated by subject matter experts outside the Government. Should such outside evaluators be used, they will be required to sign a non-disclosure statement before being provided access to Whitepapers. Only Applicants with the most highly rated Whitepapers will receive an invitation to submit a Proposal, as well as feedback on the Whitepaper. An Applicant that does NOT receive an invitation from the Government to submit a Proposal is NOT eligible to submit a Proposal and will NOT receive any feedback or "debriefing" on their Whitepaper. An Applicant not receiving an invitation to submit a Proposal will be informed of such via email following the Whitepaper evaluations.

All timely Proposal submissions from Applicants receiving an invitation to submit a Proposal will be evaluated in accordance with the evaluation criteria set forth in this PA. All information necessary for the review and evaluation of a Proposal must be contained within the Proposal. No other material will be provided to those evaluating Proposals. An initial review of the Proposals will be conducted to ensure compliance with the requirements of this PA. Failure to comply with the requirements of the PA may result in a Proposal receiving no further consideration for award.

Whitepapers and Proposals that are in compliance with the requirements of the PA 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, managers and business specialists, will evaluate the Whitepapers and Proposals and provide the results of that evaluation to the decision maker for the Government. The decision maker will make both decisions concerning the Whitepaper down selection and award selection.

While not anticipated, the Government may enter into discussions with the most highly rated proposals. Any such discussions may be conducted telephonically or face-to-face at the Applicant’s facility. Any such meeting will be coordinated with the Applicant at the appropriate time. If discussions are held, Applicants may be invited to submit a proposal revision that will be evaluated using the same criteria as the initial Proposal.

The Government will make award to the Applicant, conforming to the PA that offers the best value to the Government, cost and other factors considered. Further, award may be

made to other than the Applicant who offers the lowest Cost Proposal. ARL reserves the right not to make an award should no acceptable Proposal be submitted.

3. Recipient Qualification

i. The Grants Officer is responsible for determining a recipient's qualification prior to award. In general, a Grants Officer will award grants or cooperative agreements 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.

Applicants are requested to provide information with proposal submission to assist the Grants Officer's evaluation of recipient qualification. For the purposes of this PA, the recipients are identified as all Consortium Members, i.e. the LRO and all LRAOs.

ii. 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):

> (1) 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);
>
> (2) 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;

(3) 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

1. 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. At that time, the Applicant will be asked to execute the CA. Award is not officially made until the CA is signed by each Member of the Consortium (included in the selected Applicant's Proposal) and the Grants Officer.

2. Administrative and National Policy Requirements

Please refer to the DoD Research and Development General Terms and Conditions at http://www.onr.navy.mil/Contracts-Grants/submit-proposal/grants-proposal/grants-terms-conditions.aspx for national policy requirement that may apply.

3. Reporting

Reporting requirements for the CA are contained in the Model CA which will be provided to all Applicants that are invited to submit a Proposal.

G. AGENCY CONTACTS

Questions or comments concerning this PA will be posted through the CRA website at www.arl.army.mil/cra/dcist/. Questions and comments should be concise and to the point. In addition, the relevant part and paragraph of the PA should be referenced. Responses to questions received will be posted to the CRA 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 in the question when posed. Answers to questions of a proprietary nature will be provided

via email directly to the poser of the question. A location on the website will be provided for Applicants to post their availability for teaming with others.