U.S. ARMY RESEARCH OFFICE

In partnership with

The Intelligence Advanced Research Projects Activity (IARPA)

BROAD AGENCY ANNOUNCEMENT FOR

Advanced Graphic Intelligence Logical Computing Environment (AGILE)

W911NF-22-S-0001-01

Issued by:

U.S. Army Contracting Command-Aberdeen Proving Ground

Research Triangle Park Division

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I. OVERVIEW OF THE FUNDING OPPORTUNITY

A. Required Overview Content

A.1 Federal Agency Name(s)

U.S. Army Research Office

Issuing Acquisition Office:

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

A.2 Funding Opportunity Title: Advanced Graphic Intelligence Logical computing Environment (AGILE)

A.3 Announcement Type

Initial Announcement

A.4 Research Opportunity Number

W911NF-22-S-0001-01

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

12.431 – Basic Scientific Research

A.6 Response Dates

Proposals: 4:00 PM Eastern Standard Time on: January 24th, 2022. See Section II.D.4 for additional information.

B. Additional Overview Information

This Broad Agency Announcement (BAA) which sets forth research areas of interest to the Army Research Laboratory- Army Research Office (ARL-ARO) and the Intelligence Advanced Research Projects Activity (IARPA) is issued under paragraph 6.102(d)(2) of the Federal Acquisition Regulation (FAR), and 10 USC 2358 which provides for the competitive selection of basic research proposals. Proposals submitted in response to this BAA and selected for award are considered to be the result of full and open competition and in full compliance with the provision of Public Law 98-369, "The Competition in Contracting Act of 1984" and subsequent amendments.

The Department of Defense (DoD) agencies involved in this program reserve the right to select for award; all, some, or none of the proposals submitted in response to this announcement. The participating DoD agencies will provide no funding for direct reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this BAA will not be returned. It is the policy of participating DoD agencies to treat all proposals as sensitive, competitive information and to disclose their contents only for the purposes of evaluation.

II. DETAILED INFORMATION ABOUT THE FUNDING OPPORTUNITY

A. Technical Overview

A.1 Funding Opportunity Description

The U.S. Army Research Office (ARO) in partnership with IARPA seeks research and development of innovative, energy-efficient, reliable computer architectures for the DoD and the Intelligence Community (IC) to implement large-scale data-analytic applications, as well as other classes of large problems. The primary focus of this program, Advanced Graphic Intelligence Logical computing Environment (AGILE), is the development of new system-level intelligent mechanisms for processing, moving, accessing, and storing large, unfiltered, time-varying data streams and structures that allow for the scalable and efficient execution of dynamic graph analytic workflows.

The overarching goal for the AGILE program is to create novel computer architectures and designs that overcome the challenges specified below. The AGILE program will result in the delivery of Detailed Designs, whose performance has undergone rigorous and independent Testing and Evaluation. Pending results of this program, IARPA and ARO may support a follow-on program to develop prototypes of the proposed architectures.

A.1.1 Introduction and Background

Today's new era of explosive data growth poses serious challenges for the DoD and the IC in monitoring adversarial activities and predicting future adversarial actions. This burgeoning data, which is increasing exponentially not only in volume, but in velocity, variety, and complexity, already far outpaces the abilities of current computing systems to execute the complex analytics needed to extract meaningful insights in a timely manner. The key computational problem is that today's computers were designed to address yesterday's compute-intensive problems rather than today's data-intensive problems. Transforming the massive, unstructured, heterogeneous data streams and structures into actionable knowledge could benefit from a reimagining of computing architectures and technologies – one that places primary focus on data movement, storage, and access of irregular and time-varying structures.

The data of interest is increasingly sparse, unstructured, and heterogeneous, with minimal locality (it is distributed across the computer), poor data re-use, streaming updates flowing into the system, and fine-grain data movement and parallelism. The computations to be performed are determined by the data with multiple applications simultaneously accessing the same data. These are very different conditions than those characteristic of yesterday's compute-intensive applications.

The AGILE program seeks innovative, energy-efficient, reliable computer architectures which can address the DoD's and the IC's large-scale data-analytic applications, as well as other classes of large problems. This solicitation focuses on developing new system-level intelligent mechanisms for processing, moving, accessing, and storing large, unstructured, time-varying data streams and structures that allow for the scalable and efficient execution of dynamic analytics workflows. Acceptable AGILE system designs must emphasize optimizing the fully integrated system, rather than the independent optimization of individual functionalities (e.g., memory or computation). Supporting research and development for these proposed designs do not need to be constrained by existing component interfaces and protocols, legacy architectures, or current practices. It is anticipated that a "clean sheet" approach to designing a computer system for data-intensive applications will be required to meet the AGILE goals.

The protection of the data from observation and modification by unauthorized agents and concurrently running applications must be a fundamental capability of any AGILE architecture and must be considered during all design phases, not layered on afterward. Structures and mechanisms must be included (e.g., hardware root of trust and encryption) that can impede an adversary's ability to obtain or modify data or software or alter the hardware/software to create backdoors or malicious circuitry. AGILE computers must be able to withstand remote hacking attempts and insider threats.

A.1.2 Program Scope

The AGILE program is envisioned as a 36-month effort with two phases. Phase 1 will last 18 months, and Phase 2 will last 18 months.

The overall goals for the AGILE program are to create novel computer architectures and designs that overcome the challenges specified below. The AGILE program will result in the delivery of Detailed Designs, whose performance has undergone rigorous and independent Testing and Evaluation (T&E) using the application modeling and simulation environment described in Section A.2.6 *Test and Evaluation (T&E).* The proposed designs must have the following characteristics:

1. Efficient and scalable when executing large-scale data analytics including streaming analytics;
2. Energy efficient, reliable, and able to support scaling from a deskside system to large multi-cabinet configurations. Energy efficiency should be at least equal to today's computer systems but higher is preferred;
3. Cost effective. The price of computation should be at least equal to today's computer systems but less expensive is preferred;
4. Secure from an adversary attacks;
5. Realizable in silicon prior to approximately 2030;
6. The IP utilized in the design must be open sourced or licensable by the US Government; and
7. Able to meet the metrics described in Section A.2.3 Program Metrics and Goals.

We will release four workflows plus their derivative kernels, and three industry standard benchmarks to drive the research and development of the AGILE system designs. Offerors should propose a research project that develops a computer design driven by the four AGILE Workflows, Kernels and Benchmarks. These workflows are described in Section A.2.5 **GFI/GFE** and Appendix A. Benchmarks are described in Section A.2.3 Program Metrics and Goals.

Offerors must propose a full system design and should describe a system-level performance model, including the performance factors. The proposal should describe how the data analytics problem provided in this BAA impacts the performance factors. The proposal should also tell how the proposed performance model will drive the design decisions.

Achieving AGILE program goals will require utilization of the four end-to-end AGILE Workflows, Kernels and Benchmarks in the co-design process. In this document, AGILE Workflows, Kernels, and Benchmarks will be referred to as AGILE Applications. Performers will be provided a collection of Government Furnished Information (GFI) workflows and kernels based on AGILE workflows. However, Performers will need to develop their own micro-kernels to initiate the co-design of their components and to substantiate their capabilities. The AGILE

program will provide Performers with GFI source code for workflows written in C++, plus workflow-based kernels and links to industry-standard benchmark codes or benchmark descriptions to be used in both the co-design development process and to evaluate the performance of the resulting AGILE designs. For each AGILE workflow and kernel, a test suite at different scales will be provided.

Performers' designs will be tested and evaluated using the AGILE-enhanced Structural Simulation Toolkit (A-SST), which is based on the open-source software toolkit, Structural Simulation Toolkit (SST), developed by Sandia National Laboratories. A-SST provides the infrastructure for modeling and simulating components, node designs, and system designs. Although Performers will be responsible for reporting the performance of their designs on the AGILE metrics, their results will need to be independently verified using A-SST. Performers' design characteristics and performance will be further evaluated using an FPGA hardware emulation platform and any other tools deemed appropriate by the T&E Team. The FPGA emulation platform will primarily be used for the validation of and detailed circuit-level timing analysis for the components. All Performers will be provided the A-SST software and given access to an FPGA emulation platform by the T&E Team for the Performers to use at their own discretion. Alternative to using of the FPGA emulation platform, Performers may instead use the equivalent Berkeley FireSim emulator running on an Amazon F1 FPGA instance but will need to pay for its use out of their project funds. The Performers must supply their design specification using design-tool-neutral modeling or hardware description artifacts that can be imported to A-SST (SystemC, C/C++, SST, Verilog, or System Verilog). More details on the design and model descriptions are provided in Section A.2.6 Test and Evaluation (T&E)OBJ.

Funded AGILE projects will be openly discussed in public forums, such as workshops and conferences. Topics discussed will include the research approaches, the architecture and designs, and the performance estimates' design or components. Background IP may remain proprietary, but Performers must be willing to discuss openly how the IP is used in their design and must make a version of the background IP available for use within A-SST, with terms and conditions that T&E partners can accept, and with correct timing results.

Definitions for most of the AGILE program related technical terms used in this BAA are in Appendix C: *Definitions*

A.1.3 Program Out-of-Scope

The following areas of research or technical approaches are out of scope for the AGILE program, and proposals that include such initiatives are not awardable:

- Approaches that are likely to result in only incremental improvements over the current state-of-art.
- Approaches that do not leverage the AGILE Applications or cannot be tested and evaluated using A-SST.
- Approaches with significant limitations on operating conditions or operational parameters, such as cryogenic computers.
- Design of power distribution and cooling systems for the proposed architecture.
- Designs that cannot be realized in silicon prior to approximately 2030.
- Designs that consist of Intellectual Property (IP) that is not open-sourced or licensable by the US Government.

- Designs that do not provide efficient and scalable execution of large-scale data analytics, including streaming analytics.
- Development of integrated circuits that are not required for the Offeror's design.
- Energy inefficient design.
- Partial solutions that cannot be independently tested and evaluated against program metrics.
- Research that does not have strong theoretical and experimental foundations, or plausible scientific support, for the Offeror's claims.
- Resulting system that will not be cost effective.
- Solutions that cannot be made sufficiently robust for real-world use.
- System designs that do not scale from a deskside system to large multi-cabinet configurations.

The AGILE program does not involve the development of a complete programing environment. However, the runtime system and memory models will clearly have an impact on programming. Offerors should provide a vision for the anticipated programming environment and describe the methodology for converting a program written in a high-level language into an optimal executable. Proposals should address issues concerning how programmers will develop applications for the new architecture, and how the programming model contributes to improving performance, scalability, and productivity.

A.1.4 Team Expertise

The Performer teams should be multidisciplinary and may include expertise and experience in multiple fields related to the AGILE program goals. Therefore, collaborative efforts and teaming is highly encouraged. Teams are encouraged to include researchers with experience in innovative, leading-edge computing technologies and may consist of academic and industrial researchers and developers. The Principal Investigator (PI) should have experience managing a substantial, complicated research and development project. This individual could come from an academic institution, a small company, or a large company.

A.2 Program Structure

A.2.1 Technical Challenges and Research Areas

AGILE systems must be capable of processing large-scale data-analytic applications at least 10x faster than today's departmental-level multi-cabinet computer systems. The proposed AGILE architecture should have a hierarchical and modular design. The design must scale from a single node to a multi-node system, and should not be constrained by industry commodity components, industry standard protocols, or execution policies. However, the design may include interfaces to commodity components such as accelerators or memory devices.

Proposed computer system designs will consist of four fundamental functions:

1. *Communication* – the web that permeates the computer structure to provide mechanisms for moving data and executing message-driven remote actions (between and within the nodes in the AGILE System).
2. *Memory* – mechanisms for accessing and storing the data.
3. *Computation* – mechanisms for the execution and flow control of tasks.
4. *Runtime* – infrastructure for executing system and computational tasks.

For AGILE, these four functions must be developed in coordination with one another to ensure that innovations in one function are not negated by bottlenecks in another (i.e., the fully integrated

system must demonstrate the cooperative advantages of its subsystems). The key technical challenges are as follows:

1. *Processing elements designed to execute efficiently a broad spectrum of data-driven methods.* Proposed AGILE systems should not rely on one or two assumptions regarding the regularity and predictability of memory accesses or instruction mix because no one or two assumptions apply universally to all the workloads. AGILE data-analytic applications generate workloads where the execution patterns have poor spatial and temporal locality, and instruction streams have numerous branch-conditions that cannot be predicted ahead-of-time. Furthermore, the amount of work executed by any given thread, and/or the amount of data produced from any kernel invocation, may be data dependent and not predictable a priori.
2. *Fine-grain, irregular data movement ranging from the processing elements to the system level.* Applications with irregular, unpredictable, and data driven memory requirements will need systems to support alternative approaches to minimize/hide latencies from processing element to system level. Current approaches – multithreading and partitioning – have advantages and disadvantages. For example, multithreading can generate a sufficient number of fine-grain memory requests to saturate communication channels; however, the efficiency of data movement can suffer from the overhead of setting up the data transport and the inefficiency of transmitting a package or packet. These efficiency problems, plus the diversity of workload requirements, will require some manner of reconfigurability and adaptive control of dataflow, bandwidth allocation, and resource allocation/disaggregation. The sheer volume of data managed by this system is expected to be more than a petabyte (PB) and could require innovations in memory address translation, hybrid volatile/non-volatile storage systems, and potentially novel data compression and recoding technologies.
3. *Parallelism at all levels (fine-to-coarse grain).* This includes self-discovered parallelism since, for example, graph processing for irregular, time-varying structures has parallelism that can only be discovered in real time. The high percentage of fine-grain tasks may necessitate asynchronous operations.
4. *New memory and storage architectures for unstructured, dynamic irregular data structures.* AGILE Applications may have non-regular structures whose number, shape, and size are not known until runtime and may change dynamically during runtime. This creates challenges for conventional page-based memory management and data layout in memory structures. Moreover, the creation and deletion of these data structures may need to happen asynchronously at large scale, which creates huge challenges for memory consistency models at both, the node and system scale. The data properties (the base type) may be highly varied and unknown until runtime.
5. *An I/O subsystem capable of ingesting high-velocity streams of data from multiple external sources.* POSIX filesystem[1] semantics make it very challenging to ingest data from multiple data sources into a file interface that has sequential semantics while still maintaining global consistency across all clients. The software interfaces and layered abstractions to access non-volatile and high-capacity storage are increasingly mismatched with the underlying technology.

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[1]POSIX.1-2008, IEEE 1003.1-2008, The Open Group Base Specifications Issue 7. URL: http://pubs.opengroup.org/onlinepubs/9699919799/

6. *System security, data integrity, and compliance services to support multiple applications working cooperatively in the same memory space.* For AGILE systems, the access control apparatus must allow a common approach to managing authentication and authorization, which works across nonvolatile storage and volatile memory. This contrasts with modern high-performance computing systems, in which multi-tenancy usually involves many different users and applications with different access credentials that are able to share a common database. Both efficient data transport and end-to-end data integrity protection are essential.

The runtime system presents an abstraction of the computing system software structure and operation for a specific system architecture. The design provides a fundamental conceptual framework for the co-design of technology: architecture, programming interfaces, and system software. The designs of the runtime system should therefore be used as the conceptual framework for overcoming the above challenges.

When developing an AGILE design, Performers must utilize the co-design methodology (see Figure A.2.1-1) at all levels of the AGILE architecture to ensure that: (a) components are designed appropriately, (b) all subsystems cooperate to optimize performance and eliminate data-movement bottlenecks at the system level, and (c) both system designs and AGILE Applications are simultaneously optimized. The co-design process will enable the system design and the application codes to be iteratively optimized. The T&E Team will utilize the A-SST environment to perform metric measurements of the design.

Figure A.2.1-1 AGILE Co-Design Process.

Possible areas of research for AGILE include, but are not limited to:

- **Tightly integrated design** (communication, memory, compute & runtime) resulting in a unified, efficient, and scalable system with transparent access to data and compute resources throughout the system.

- **Data-driven compute elements** optimized for the AGILE Applications, supporting efficient data movement that provides low-latency, high-bandwidth data accesses, and moving the compute to the data.
- **Distributed memory management and security system** that efficiently supports fine-grained addressing and protection of objects and data across the system.
- **System-level intelligent mechanisms** for processing, moving, accessing, and storing large, unstructured, time-varying data streams and structures.
- **Global name space/global adaptive data transfer mechanism** to enable efficient data movement and adaptation of information flows to match complex AGILE Applications requirements.
- **Dynamic adaptive runtime systems** to match activity demands to changing resource availability.

Offerors should address these technical challenges and propose additional technical challenges they plan to investigate. Offerors must provide an explanation of how their proposed architecture will address the technical challenges.

A.2.2 Program Phases

The AGILE program will proceed in two phases, which are designed to enable Performers to create innovative, scalable, and efficient computer architectures driven by data-intensive problems (as described in Section A.2.5, *GFI/GFE*), and to develop those architectural concepts into progressively capable designs described by increasingly accurate models that will be quantitatively evaluated for performance on AGILE program metrics (as described in Section A.2.3). Table A.2.2-1, *AGILE Program Phases*, summarizes the two phases and lists their characteristics.

Phase 1: Architectural Design (18 months)

The objective of this eighteen-month Phase 1 is to provide a system-level architectural design in the form of a model that will meet the performance metrics shown in Section A.2.3 of this BAA. This Architectural Design must be characterized by a set of high-level behavioral models (see Appendix C: *Definitions*) suitable for estimating all aspects of its performance on the AGILE Applications and program metrics in the A-SST environment. The Phase 1 high-level Architectural Design may need to be a multi-resolution set of models, ranging from fine granularity at the circuit level to coarse granularity at the multi-node system level. More details on the development of this suite of models are provided in Section A.2.6. During the course of Phase I, Performers will be provided GFI AGILE Applications. Performers will be expected to utilize the GFI AGILE Applications to identify system bottlenecks and create innovative solutions that improve the overall performance and efficient resource utilization of the new system. It is anticipated that some Detailed Designs will include new integrated circuits designs; the accuracy of the timing models for these circuits will need to be validated by the Performers and verified by the T&E Team. Performers will generate comprehensive test plans and test suites required to evaluate their system architecture designs. This includes completeness, correctness, functionality, system characteristics, and performance estimates on the AGILE Applications. Any modifications to the GFI application suite (AGILE Applications) codes to optimize them for the new architecture being developed is the responsibility of the Performers. While Performers are free to use any industry standard architectural development environment that they select, the performance evaluations and their verification by the T&E Team will be conducted using A-SST. The description of the high-level behavioral model must be provided in design-tool-neutral IEEE-standard format (either

SystemVerilog, SystemC, or C/C++) that can be imported into the A-SST environment for independent testing and verification by the T&E Team. It is the performer's responsibility to ensure interoperability with the A-SST framework.

Table A.2.2-1 AGILE Program Phases

Area	Phase 1 (18 months)	Phase 2 (18 months)
Design review	Preliminary design review	Critical design review
Application Test Plans, with test suites	Validate the completeness & correctness of the AGILE Applications modified for the Architectural Design	Validate the completeness & correctness of the AGILE Applications modified for the Detailed Design
Hardware Test Plans, with test suites	Validate the completeness, correctness, functionality, system characteristics, and performance of the Architectural Design	Validate the completeness, correctness, functionality, system characteristics, and performance of the Detailed Design
Workflow and kernel codes	Optimize for Architectural Design	Optimize for Detailed Design
Application software framework	Prototype development tools and libraries for the Architectural Design	Prototype development tools and libraries for Detailed Design
Models/designs	Architectural designs, including high-level behavioral designs and abstracted node & system-level models	Detailed Design, including RTL designs/functional models, with abstracted node & system-level models

The use of A-SST for independent testing of the designs is described in Section A.2.6. A-SST and an FPGA emulation platform will be available to Performers at the start of the AGILE program. The AGILE T&E Team will assess the system architecture using the A-SST environment and the test suite generated by the Performers as well as sequestered test-sets that are developed by the T&E Team. This will allow IARPA and ARO to perform independent verification and validation to measure the completeness, correctness, functionality, system characteristics, and performance of the proposed Architectural Design.

At the conclusion of Phase 1, the Performers must make a compelling argument, supported by the T&E Team's independent evaluation of their designs and simulated performance results, that their Phase 1 Architectural Design and future design approach will meet the AGILE metrics at the end of the program. The Architectural Design must be capable of being imported into the A-SST environment to enable performance estimates for a multi-node simulation of the AGILE Applications.

The diagram in Figure A.2.2-1 presents a possible structure of the Architectural Design.

Architectural Design Structure

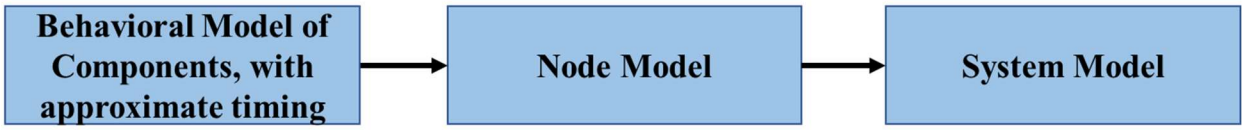

Figure A.2.2-1 Representation of a potential structure of the Architectural Design

Phase 2: Detailed Design (18 months)

The objective of this eighteen-month Phase 2 is to provide a Register Transfer Level (RTL) design of the AGILE system developed in Phase 1 (plus continuing innovations). If Performers' designs include Commercial-Off-The-Shelf (COTS) components, this design can be a hybrid design composed of *Functional* or *High-level Behavioral* models (see Appendix C: *Definitions*) for any COTS components in the system and RTL designs for each AGILE-developed integrated circuit. The Phase 2 design may need to be a multi-resolution set of designs, ranging from RTL at the circuit level to coarse granularity at the multi-node system level. The Detailed Design will include components, node designs, and system-level interconnect models for a full system design. This might require a mixed-resolution system model, where both RTL models and higher-level models run in the same simulation, connected together with the system-level interconnects for system-level simulations.

Performers will focus on the detailed implementation of the AGILE system architecture developed in Phase 1, including the logic design of any Application Specific Integrated Circuits (ASICs) and/or Field Programmable Gate Arrays (FPGAs) contained in the system design. The Phase 1 Architectural Design shall be kept up to date with any architectural changes made to the Detailed Design.

As in Phase 1, Performers shall generate a comprehensive test plan and test suite required to evaluate their design. This includes completeness, correctness, functionality, system characteristics, and performance estimates on the AGILE Applications. Any modifications of the GFI application suite (AGILE Applications) codes to optimize them for the developing AGILE architecture shall be the responsibility of the Performers. As in Phase 1, although Performers are free to use any industry standard development environment, the hardware description must be provided to the AGILE T&E Team using a design-tool-neutral, IEEE-Standard hardware description language – Verilog or synthesizable SystemVerilog for Detailed Design components and SystemVerilog, SystemC, or C/C++ for High-Level Behavioral models. As in Phase 1, it is the performer's responsibility to ensure interoperability with the A-SST framework. The AGILE T&E Team will assess the system design using the A--SST environment and the test suite generated by Performers. This will allow IARPA and ARO to perform independent verification and validation to measure the completeness, correctness, functionality, system characteristics, and performance of the Detailed Design.

Deliverables for Phase 2 include a node level design capable of being used to accurately simulate and model a multi-node system. Performers must provide tests results that verify that all IP used in the design has been validated and deliver a test plan and test suite for the system design and its components. The Performers will deliver the hardware description in either IEEE-Standard SystemVerilog or Verilog so that it can be imported into A-SST for evaluation by the T&E Team.

Any components that are not expressed in an HDL[2] (Verilog or SystemVerilog) must have their high-level C/C++ behavioral model delivered as either SST or SystemC components. They shall also deliver their modified versions of the AGILE Applications codes for evaluation and use by the T&E Team. Finally, Performers must deliver design documents and modeling, and/or other calculations to demonstrate that the design, when manufactured, can be expected to meet all AGILE program goals.

The diagram in Figure A.2.2-2 presents a possible structure of the Detailed Design.

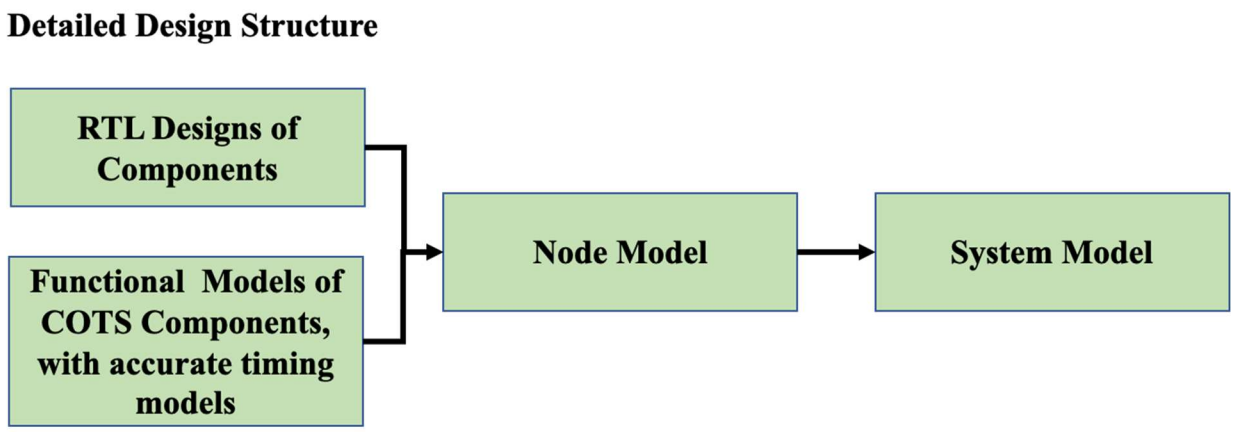

Figure A.2.2-2 Representation of a potential structure of the Architectural Design

A.2.3 Program Metrics and Goals

Achievement of metric goals is a critical factor that will be taken into account when determining whether to continue work under IARPA/ARO research contracts. IARPA/ARO have defined program metrics to evaluate effectiveness of the proposed solutions in achieving the stated program goal and objectives, and to determine whether satisfactory progress is being made.

The AGILE target metrics described in this BAA are shared with the intent to bound the scope of the effort, while affording Offerors maximum flexibility, creativity, and innovation in proposing solutions to the stated problem. Performance metrics are based on today's departmental-level multi-cabinet computer systems and the goals were selected based on the following factors:

1. What is deemed technically feasible based on emerging microelectronics and computer system research but challenging based on current computer system capabilities.
2. What is useful to mission partners?

Proposals with a plan to exceed the defined metrics in one or more categories are desirable, provided that all of the other metrics are met. All proposals must provide clear justification as to why their proposed approach will be able to meet or exceed the enhanced metric goals. Offerors should provide an analysis of the fundamental algorithms for each AGILE Workflow metric and describe how their proposed architecture will provide the required performance improvement compared to the performance expectations on a computer system that is available at the time of this proposal. During the first phase of the AGILE Program, Architectural Design, Performers

[2] HDL = Hardware Description Language

will present a Preliminary Design document at Month 9 of their proposed architecture. The Preliminary Design document will provide the anticipated metrics values that will be achieved by the proposed architecture for each standard benchmark and AGILE Workflow metric. The AGILE targeted values for each of the Workflow components described in Section A.2.5, are shown below in Tables A.2.3-1 through A.2.3-4.

Table A.2.3-1 Workflow: Knowledge – Groups, Relationships & Interests

Metric	Today	AGILE Target
Data ingestion rate	0.1 G[3] data-elements per second from a Single source, single data type	10 G data-elements per second from 3 or more sources and data types(100x faster for 3 sources
Time to learn embedding (Graph Size > 1 PB)	1,440 minutes	30 minutes (48x faster)
Time to classify vertices and edges	> 1,440 minutes	30 minutes (> 48x faster)
Time to predict and infer new relationship	> 1,440 minutes	30 minutes (> 48x faster)
Time to reason about higher-order relationships using multi-hop reasoning	1 – 2 hops (exact matches) in 30 minutes	3 – 5 hops (approximate/fuzzy matches) in 1 minute (30x faster)

Table A.2.3-2 Workflow: Detection – System and Event Patterns

Metric	Today	AGILE Target
Size of graph	0.01 PB[4]	10 PB (1000x larger)
Data ingestion rate	0.1 G data-elements per second from a	10 G data-elements per second from a

[3] G = 10^9
[4] PB = 10^{15} Bytes

	single source, single data type	three or more sources and data types (100x faster for 3 sources)
Insert/Delete/Modify rate for vertices and edges	0.01 G *edits* / second (batched)	10 G *edits* / second (continuous) (1000x faster)
Pattern Detection per minute	Single event, linear paths, exact match	Multiple events, branches, prioritized approximate/fuzzy matching
Incremental analysis	NOT DONE	Commensurate with data rate
Time to complete multiple day / multiple location queries	NOT DONE	Completed in minutes

Table A.2.3-3 Workflow: Sequence Data – Identification and Clustering

Metric	Today	AGILE Target
Data ingestion rate	1 M records per second from a single source	10 M records per second from 3 or more sources (10x faster for 3 sources
Records processing rate	0.1 M per second	10 M per second (100x faster)
Time to construct similarity graphs using metrics such as Jaccard index	400 hours[5]	6 hours[6] (67x faster)
Time to cluster similarity networks	500 hours[2]	10 hours[3]

[5] Assumes a graph of 10 billion vertices and 100 billion edges running on departmental size cluster

[6] Assumes a graph of 1 trillion vertices and 100 trillion edges

		(50x faster)
Time to predict labels (functions) of new sequences	200 hours[2]	4 hours[3] (50x faster)
Time to estimate uncertainties of labels and functions, and prioritize alerts	NOT DONE	Completed

Table A.2.3-4 Workflow: Network – Cyber-Physical Systems

Metric	Today	AGILE Target
Construct 1 PB graph through game theoretic modeling	120 minutes	2 minutes (60x faster)
Identification of top *k* influential nodes (simple model)	60 minutes	1 minute (60x faster)
Identification of top *k* influential nodes (enhanced model)	600 minutes	30 minutes (20x faster)
Propagate labels/confidence score	120 minutes	2 minutes (60x faster)
Incremental analysis	NOT DONE	Never recomputed from scratch

Benchmark Codes

- Breadth First Search (BFS) - https://graph500.org/
- Triangle Counting - http://graphchallenge.mit.edu/
- Jaccard Coefficients - https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7529958

Benchmark Assumptions

- System has 1+ PB of storage for graph data
- A core represents a basic computing element, within the system, capable of executing graph algorithms and loading data from a memory
- Overall performance target metric is: 10x faster than a conventional system, that has 1 PB storage

Graph Data Properties

- Utilizes the Graph500 Benchmark datasets (http://graph500.org/)

- Scale 36: 2^{36} vertices & storage 17.6 TB[7]
- Scale 42: 2^{42} vertices & storage 1.1 PB

Beyond the performance metrics specified in, Table A.2.3-5, Benchmarks, the Offeror's proposal should include estimated wall clock time, memory and network metrics, and resource utilization also need to be reported.

Table A.2.3-5 Benchmarks

Benchmark Metric	Target Metrics		
	Scale 36	Scale 42	Report
Breadth First Search (BFS)	1 GTEPS[8]/core	1 GTEPS/core	Traversed edges per second (TEPS)
Triangle Counting	1 M[9] triangles/sec/core	1 M triangles/sec/core	Number of triangles & number of 2-paths
Jaccard Coefficients	1 M coefficients/sec/core	1 M coefficients/sec/core	Number of Jaccard Coefficients & number of Jaccard Coefficients per second

A.2.4 Program Waypoints, Milestones, and Deliverables

This section describes the program schedule, including Waypoints, Deliverables and Milestones. Waypoints, Milestones, and Deliverables are established from the program's onset to ensure alignment with AGILE objectives, organize research activities in a logical and reportable manner, and facilitate consistent and efficient communication among all stakeholders – IARPA, ARO, AGILE T&E Team, U.S. Government Stakeholders, and AGILE Research Performers. A schedule of key program Milestones and Deliverables is shown in Table A.3-1 and Table A.3-2. Milestones are significant events or actions that are required by the program.

Waypoints

Waypoints are events that are proposed by the Offerors and are a tangible measurement of Performer progress toward achieving the AGILE program objectives. Waypoints provide additional insight into the development of the key aspects of the proposed research beyond the measurement of deliverable performance metrics. They assist the program management team in providing guidance and assistance to Performer teams. Program waypoints may be refined during the various Phases of the program.

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[7] TB = 10^{12} Bytes
[8] GTEPS = 10^{9} traversed edges per second
[9] M = 10^{6}

Offeror's proposed technical and programmatic waypoints shall be included in the Offeror's proposal. For each proposed waypoint, the proposal shall describe the waypoint, its relationship to program tasks(s) and criteria for successful achievement of the waypoint, and the date by which the waypoint shall have been achieved. It is preferred that this waypoint information be conveyed in tabular format as indicated below in Table A.2.4-1.

Table A.2.4-1 Sample Waypoint Table

Phase	Months after Start of Phase	Waypoint Name	Description	Success Criteria

Mandatory Program Waypoints

The Government has identified the following two waypoints for all Performers:

Waypoint 1: Preliminary Design Review (PDR). A PDR will occur during the second site visit, expected within the first nine (9) months of contract award. The Performer must deliver documentation of the preliminary design, updated target metric values for the AGILE Applications, and implementation plan, an accurate program schedule, and a mitigation plan for identified risks. The Performers shall describe the bottlenecks they identified during their analysis and their rationale for their design trade-offs. At the PDR, Performer progress, plans, proposed optimized AGILE Applications and architectures will be presented by the Performer team and assessed by the Government with input from the T&E Team and selected advisors. The preliminary design must include the design development process including the methodology for modeling the designs.

The output of the preliminary design would be deep performance analysis of the workloads, block diagrams of the proposed system, performance assumptions for the key subsystems, justifications for those performance assumptions, an analysis of the components, node and full-system modeling methodology and determination that the designs will be evaluated using A-SST. The PM will document any deficiencies in what was presented by the Performer at the PDR or within ten (10) business days thereafter. The exit criteria for the Critical Design Review (CDR) will be discussed at the PDR. The PM may also refine the Exit Criteria for the CDR as part of the PDR documentation following the PDR. The preliminary architectural specification and Preliminary Design are deliverables

The PDR will provide the Performer's preliminary architecture specification. The CDR will also provide the methodology for modeling the architecture specification at all levels. That is, component, node and system levels. Finally, the CDR will present how the model of the architecture specification will be evaluated using the A-SST environment.

The PDR will provide the initial design of the runtime system. The proposed methodology for utilizing the runtime system in the co-design process and the evaluation of the proposed models will be presented.

Waypoint 2: Critical Design Review (CDR). A CDR will occur during a site visit to the Performer site within twenty-four (24) months of the program kick-off. At the CDR, Performer progress, final plans, Applications, and designs will be presented by the Performer and assessed

by the Government PM, with input from the T&E Team and selected advisors. The Performer will provide evidence that all CDR Exit Criteria have been met. The hardware specification is also a deliverable. Performers must also report the results of their internal testing at the CDR and describe how any deficiencies in performance will be addressed. The PM will document any deficiencies in what was presented by the Performer at the CDR or within ten (10) business days thereafter.

The CDR will provide the hardware design specification. The specification of the runtime system will be provided. Also, the approach to utilizing A-SST will be presented. The architecture specification will be updated.

The architecture, hardware and runtime specifications will be updated throughout the program.

Deliverables

Below are details concerning the AGILE deliverables, which are in addition to the PDR and CDR Deliverables. A timeline of the program deliverables follows below (see also Section A.3).

Kickoff Meeting

Performers shall provide the presentation slides and any supporting documentation from the Kickoff Meeting.

Program Wide Review Meeting (PI Review)

Performers shall provide the presentation slides and any supporting documentation for each PI Review. Supporting documentation can include written responses to questions from the Government attendees. At the conclusion of Phase 1, Performers must also make a compelling argument, supported by their performance results on the program metrics as described at the end of Section A.2.3, that their Phase 1 Architectural Design and future Detailed Design approach will meet Phase 2 metrics by the end of the program.

Site Visits

Performers shall provide the presentation slides and any supporting documentation for each Technical Review Meeting. Supporting documentation can include written responses to questions from the Government attendees.

Technical Reporting

Performers shall provide monthly technical status reports no later than 10 days after the first of each month. The technical reports shall document the status of the project and progress towards achieving AGILE metrics, including results of internal performance tests. It will also track Performers' self-determined technical project risks and corresponding mitigation strategies. Both the results presented at technical review meetings and technical reports will serve as an official record of progress.

Technical Review Meetings

Performers shall provide the presentation slides drawn from monthly status reports and any supporting documentation for each Technical Review Meeting. Supporting documentation can include written responses to questions from the Government attendees.

Financial Reporting

Performers shall provide monthly financial status reports (MSRs) not later than ten days after the first of each month. The MSRs shall summarize budget, spending plan and actual spending and an

explanation of any variance, as well as identify any financial issues that may affect the program or put achievement of program objectives at risk.

Architecture Specification

Performers shall provide an architecture specification which, as a minimum, contains a block diagram, description of the major functions of each block, major timing requirements for each block and between blocks, anticipated metric values for the system, discussion of major risks and mitigation plan, and targeted process technology for each new chip that will be designed as part of this program. The Architecture Specification will be updated as necessary during Phase 2.

Hardware Design Specification

Performers shall provide a hardware specification which, as a minimum, contains a block diagram, detailed description of the functions of each block along with timing, anticipated metric values for the system, discussion of major risks and mitigation plan, and detailed description of each new chip that will be designed as part of this program including functions, input/outputs signals, packaging diagram, timing requirements and targeted process technology.

Hardware Test Plan

Performers shall provide test plans that will specify the evaluation methodology and process they will utilize to verify the completeness, correctness, functionality, system characteristics, and performance of the Architectural Designs in Phase 1 and the Detailed Designs in Phase 2. The test results must be included in the monthly technical status reports, as appropriate. Additionally, the test plan must inform the T&E Team on how the designs can be evaluated using the A-SST environment.

Application Test Plan

Performers shall provide a plan which describes how they will confirm that the models and designs are executing the optimized AGILE application software correctly and measure the performance.

Hardware Test Suite

Performers shall provide the test vectors, programs and/or other stimulus required to verify the correct functionality and timing of the Architectural Design in Phase 1 and the Detailed Design in Phase 2. An analysis of test coverage must be included in Phase 2.

Application Test Suite

Performers shall provide the test vectors, programs and/or other stimulus required to confirm that the Architectural Design in Phase 1 and the Detailed Design in Phase 2 are executing the optimized AGILE application software correctly and measure the performance. An analysis of completeness must be included in Phase 2.

Application Framework

Performers shall provide the framework to be used to develop and optimize AGILE Applications for their Architectural Design in Phase 1 and their Detailed Design in Phase 2. This most likely includes a bare-bones compiler and other simple tools.

Application Software

Performers shall provide their version of the AGILE Application software, which has been optimized for their system design.

Architectural Design

Performers shall provide high-level behavioral models, node-level abstraction models, and parameterized system-level models that can be used for multi-node performance estimations and evaluation of the proposed AGILE architecture. The timing models for the design will be used to estimate the performance of the AGILE Applications when executed on the architecture. The models must be expressed in design-tool-neutral IEEE-Standard formats (SystemVerilog, or SystemC) or SST components that can be evaluated within the A-SST environment that is specified in Section A.2.6. Performers shall also provide documentation to the Government to enable the Government T&E to evaluate the model.

In addition to delivering an Architectural Design for T&E, Performers must deliver design documents and modeling and/or other calculations to demonstrate that the design, when manufactured, can be expected to meet all AGILE program goals.

During Phase 2, the Architectural Design shall be kept up to date with any architectural changes.

Detailed Design

Performers shall provide a Functional Model of their detailed system design which can be generated from the RTL design from each AGILE ASIC. A cycle-accurate high-level model can be used for any COTS components contained in the design. All models must be capable of being evaluated in the A-SST environment specified in Section A.2.6. Performers shall also provide documentation to the Government to enable the T&E Team to evaluate the system design.

In addition to delivering RTL files/functional designs, node-level models, and system models for T&E, Performers must deliver design documents and simulations and/or other calculations to demonstrate that the design, when manufactured, can be expected to meet all AGILE program goals.

Software Deliverable Formatting

Performers will be required to provide algorithm and software deliverables in a manner that conforms to a standardized industrial method or methods, the specifics of which will be negotiated between IARPA and Performers within two months after program kickoff. AGILE program software standards will be established for all Performers at the Preliminary Design Review and will comply with best practices for configuration management.

A.2.5 GFI/GFE

AGILE will provide an end-to-end workflow for each of four different application domains:

1. Knowledge graphs – groups, relationships & interests,
2. Detection – system and event patterns,
3. Sequence data – identification and clustering, and
4. Network – cyber-physical systems.

Each of these four workflows will be sufficiently long and complex to measure multiple quantities per workflow (e.g., data intake rate and number of graph edits per second). These quantities will be described in more detail below and in Section A.2.3. For each workflow, the AGILE program will provide a high-level description, call graph, list of key kernels, input data files, output data files, source code, and performance targets (see Section A.2.3). The source code will be for

reference purposes; Performers are free to implement the workflow in a manner that optimizes performance on their system.

The AGILE program will extract kernels from the workflows for evaluating hardware and software subsystems. For each kernel, the AGILE program will specify the data and system conditions at the kernel's call sites in the workflows. Performers are required to adhere to these conditions when modifying the workflows and kernels for the proposed architecture. The AGILE program will provide performance metrics and target goals for each kernel as well as descriptions, source code, and data.

In addition to the four workflows and kernels, AGILE will use three industry standard benchmarks for evaluation. The URLs for these benchmarks are given in Section A.2.3. Performers shall develop their own set of micro-kernels to initiate development of individual hardware components.

To indicate the data-analytic functionality that the proposed AGILE systems will need to support, the characteristics of the end-to-end workflows and their derivative kernels are described in Appendix A. Descriptions will list selected components of the end-to-end workflows and their target metrics. The AGILE application suite must be utilized by the Performers in their co-design process. The AGILE program will provide two workflows and their derivative kernels early in the program; the rest will be provided in the first half of Phase 1.

A.2.6 Test and Evaluation (T&E)

The AGILE program will pursue rigorous and comprehensive T&E to ensure that research outcomes are well characterized, that deliverables are aligned with program objectives, and that the performance of the developing AGILE systems is measured across the full spectrum of important representative data-intensive applications. Test and evaluation will be conducted by an independent team of Government and contractor personnel. The T&E Team will verify that the Performers' AGILE Architectural and Detailed Designs are complete and can achieve the target metrics for the AGILE Applications and industry-standard benchmarks described in Section A.2.3, "Program Metrics and Goals." The tests will be conducted with sequestered datasets that will be used internally by the T&E Team to evaluate the Performer designs. The T&E methodology will utilize A-SST, FireSim, and any other appropriate tools as its test bench. In addition to independent T&E, the program will regularly gauge interim progress of Performer research activities towards AGILE objectives and target metrics using T&E results measured and reported by the Performer teams themselves. These T&E activities will not only inform IARPA, ARO, and Government stakeholders on AGILE research progress but will also provide valuable feedback to the Performers to improve their research approaches, co-design practices, and system development efforts. Below are details on the testing that will be employed to measure and verify the capability of the architecture and subsequent system design.

Performer Testing

While Performers may use any development and test environment they choose, Performers' testing shall enable the use of A-SST to verify their results by the T&E Team. The Performers can use any development environment they wish to do hardware design and evaluation within their team, but the resulting artifacts must be delivered to the T&E Team in a form that is tool-neutral and can be readily imported into the A-SST testing environment. The allowable formats for software simulation of high-level behavioral models are C/C++, SystemC, or SystemVerilog. The allowable formats for lower-level functional and RTL models are synthesizable SystemC,

SystemVerilog and Verilog. The complete test environment must be approved by the IARPA Program Manager. The results of any progress testing shall be included in the monthly technical report. Progress testing shall occur at least every six months throughout program. The first monthly technical report shall contain a description of the Performer's development and testing methodology for progress testing. The Performer and the PM shall agree on the Performer's progress testing methodology no later than the 3rd month after program kickoff, with the first internal testing to be completed no later than the 6th month of the program.

Phase 1 Testing

Performers shall submit both: (1) a Hardware Test Plan and Test Suite for verifying the completeness, correctness, functionality, system characteristics, and performance of the Architectural Design, and (2) an Application Test Plan and Test Suite containing the version of the AGILE application suite software optimized for the Performers' AGILE Architectural Designs. Performers will provide an Application Framework that will enable compilation and assembly of their application codes for execution in the test environment. Both test suites will be validated by the T&E Team. Performers shall submit:

- The Performers' modified AGILE Application Suite code and the Application Framework to enable the code to run on the target platform. If the Performers' Architectural Design includes COTS components where the high-level behavior model is not provided, , then the Performer must supply trace files and/or trace file generation methodology to enable those traces to be evaluated using A-SST with a trace-driven simulation proxy for the component.
- Documentation of the interfaces needed for code-to-architecture compilation and execution.
- Documentation for the Performers' high-level behavioral models and design-tool-neutral IEEE-Standard format (SystemC, SystemVerilog, or C/C++) components that can be imported into the A-SST environment to be tested and evaluated.

The T&E Team evaluation of the performance of each AGILE Architectural Design will involve A-SST.

Phase 2 Testing

Performers shall submit both: (1) an updated Hardware Test Plan and Test Suite for verifying the completeness, correctness, functionality, system characteristics, and performance of the RTL designs, plus higher-level abstraction models, for their AGILE Detailed Designs, and (2) an updated Application Test Plan and Test Suite containing the updated version of the AGILE application suite software optimized for the Performers' Detailed Designs. Performers will provide an updated Application Framework that will enable compilation and assembly of their application codes for execution in the test environment. Both test suites will be validated by the T&E Team. Performers shall submit:

- The Performers' modified AGILE Application Suite code and the Application Framework to enable the code to run on the target platform. If the Performers' Detailed Design includes COTS components where the high-level behavior model is not provided, then the Performer must supply trace files and/or trace file generation methodology to enable those traces to be evaluated using A-SST with a trace-driven simulation proxy for the component.

- Documentation for the Performers' RTL designs and functional models, described in either SystemC, SystemVerilog or Verilog hardware description languages

The T&E Team will test the performance of each Detailed Design using the Performers' RTL designs and associated models by utilizing A-SST.

A more detailed schedule of deliverables and testing events is provided in Section A.3, *Program Timeline and Deliverables*.

Modeling Methodology and T&E Team Testing

The T&E Team will independently verify progress towards achieving program objectives at prescribed points during the program. Advancement toward achievement of program goals at these prescribed points is a condition for continued participation in the AGILE program.

Phase 1 will require flexibility to rapidly design and adapt system components to the AGILE Applications. As such, its modeling and simulation approach will use high-level behavioral models that capture the behavior of the component at an instruction or transaction level with an approximate notion of timing. While Performers may focus on node-level technologies, the impacts of intra-node changes on the whole system must also be evaluated. However, even high-level node models running at instruction granularity may be too slow to easily model entire (multi-node or multi-cabinet) systems, required for system performance evaluation on end-to-end workflows.

In Phase 2, AGILE Performers will provide RTL designs or functional models for any COTS components in their architecture from their Phase 1 Architectural Designs using design-tool-neutral IEEE-Standard hardware description languages (Verilog or SystemVerilog). In cases of COTS components where the HDL is not available, the Performers will provide captured traces of communication patterns and other traces (memory or other transactions) of the AGILE Applications that can be used to model their AGILE design performance. The T&E Team will use the A-SST simulation framework (SST [10,11] for tutorials) and the FireSim FPGA hardware simulation (see [12]for tutorials of the FPGA system) to evaluate the Performers' design.

Offerors may also propose their own methods for augmenting the A-SST environment to achieve their proposed architectures' performance estimates. However, this methodology must be validated and approved by the T&E Team. It is the Performer's responsibility to develop the additional software required for the modeling and simulation of their design in this circumstance.

A-SST is a tool for evaluating a performance model. Since Performers may use a variety of different design tools, Performers will utilize platform-neutral exchange formats for expressing models and designs that can be imported into A-SST for T&E. The taxonomy will be based upon what a typical hardware engineering team uses to describe their design at the different levels of abstraction. This taxonomy will allow for exchange formats that are compatible with how a hardware engineering team feeds its design to various tools but will enable performance evaluation using A-SST.

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[10] http://sst-simulator.org/
[11] https://github.com/sstsimulator/
[12] https://github.com/firesim

Examples of exchange formats are: Verilog, Verilog-A, SystemVerilog and System-C.

To enable validation and verification by the T&E Team, Performers must abide by the following:

1. For High-Level Behavioral Models, Performers will provide the models to the T&E Team in the form of SystemC, SystemVerilog or C/C++ Components.
2. For the Functional Models, Performers will provide the models in the form of IEEE-Standard Verilog, SystemVerilog or IEEE-Standard SystemC.
3. For the RTL level models, Performers will provide the hardware description in the form of System Verilog or Verilog.
4. For any models of Circuits or Analog components (if any), Performers will describe the model using Verilog-A.
5. For circuit timing analysis, Performers will provide the timing analysis report from the tool they are using (Synopsys, Cadence, Mentor, and Yosys) and all of the scripts & circuits that were evaluated so that the experiments could be evaluated thoroughly by the T&E Team. The information provided by Performers should enable the T&E Team to recreate these reports and data, as needed.

Following the above requirements will enable A-SST and the FPGA emulation platform to serve as a common test-bench to be used by the T&E Team for independent testing of the Performers' designs. A-SST will be used primarily for functional/behavioral analysis and performance estimation, while the FPGA emulator will be used primarily for the validation of and detailed circuit-level timing analysis for the HDL description of the components.

<u>One key area of concern is the modeling and simulation of the runtime system, particularly if it includes innovations such as introspection (execution efficiency monitoring) and adaptation (re-allocation of system resources). Offerors are encouraged to consider how their proposed runtime will be modeled and simulated, and to describe how the results will impact the ability to estimate the performance of their proposed AGILE architectures</u>.

Phase 1: Architectural Design

The T&E test process in Phase 1 will include the use of high-level behavioral models. The intent of these models is not to provide precise circuit timing but to produce sufficiently functionally correct results and approximate timing to ensure expected system behavior and provide initial performance estimates of adequate accuracy to justify the design. The models will be used to evaluate software, such as the runtime system, in the context of the provided AGILE Applications. To evaluate performance at scale, instruction-level simulation will need to be coupled to more abstract node models for whole-system simulation.

Many performance and scalability effects of the Performers' architectures will only be evident at scale. Thus, it will be necessary to model proposed components at two different resolutions – node and multi-node system. These simulations will enable Performers to develop approximate estimates for execution times of the most important computational/memory subsystem kernels. Timings taken from the node simulations can then be used to parameterize high-level behavioral models of the full system (including network/interconnect behavior). This process is inherently iterative, allowing the Performers to gradually refine their models to improve accuracy/fidelity (as needed), and to gradually increase the size/scale of the full-system analysis. The resulting system design is the Architectural Design.

Phase 2: Detailed Design

In Phase 2, the T&E Team will provide guidance to AGILE Performers in developing and integrating their RTL designs and cycle-accurate Functional Models into A-SST using IEEE-Standard hardware descriptions using Verilog or SystemVerilog. The Performers will use A-SST to generate accurate estimates of component and/or node kernel timings to develop a more accurately parameterized version of their Phase 1 Architectural Design. This will be an iterative process allowing the full AGILE team to focus on areas of potential technology risk, slow performance, or limits on scalability. Phase 2 will provide much more detailed, performance analysis enabling high confidence finalized designs. The resulting system design is the Detailed Design.

As the Performer designs become available, the T&E Team will evaluate them to determine if any of the proposed timings for RTL designs require further validation or analysis (e.g., synthesis and timing validation).

As noted previously, the performance of the Detailed Design that includes the AGILE RTL designs, plus node-level abstractions and parameterized system models, will be tested on the full AGILE application suite at the end of Phase 2.

Runtime Modeling Considerations

The T&E Team will provide guidance to the Performers in modeling their runtime system based on where they are in the program:

- Phase 1 modeling and simulation goal is flexibility. While it is the Performers' responsibility to provide the modeling and simulation of their runtime system, the T&E Team will support those efforts by importing the Performer-supplied design elements into the A-SST environment.
- Phase 2 will rely more on detailed execution-based simulation using RTL designs. This will require the runtime system and application stack to be more fully developed and complete. The T&E Team will assist the Performers in creating abstracted models of the runtime system that can run in mixed-resolution simulation. These models will have to capture sufficient runtime system details to prove out the concepts while still being able to scale to tens of thousands of instances.

A.3 Program Timeline and Deliverables

The AGILE program will follow the timeline in Table A.3-1, which shows dates for milestones, testing, and various program review meetings, including site visits. Table A.3-2 shows the Deliverables and their schedule.

Table A.3-1 Program Milestones, Meeting and Testing Schedule.

Event	Months after Program Start-	
	Phase 1 18 MONTHS	**Phase 2 18 MONTHS**
Kickoff Meeting (Beginning of each Phase)	1	19
Program Wide Review Meeting	6, 12, 18	24, 30, 36
Technical Review Meeting	Monthly when no in-person meetings are scheduled	Monthly when no in-person meetings are scheduled
Site Visits	3, 9, 15	21, 27, 33
Preliminary Design Review	9	22
Critical Design Review	-	24
Research & Development Efforts Completed	Architectural Design 16	Detailed Design 35
T&E Assessment	17 - 18	35 - 36
End of Phase	18	36

Table A.3-2 Program Deliverables Schedule.

Deliverable	Due Date	Description
Kickoff Meeting Presentation	7 days before meeting	Read-ahead package containing the slides that will be presented. Must include accurate program schedule and risk mitigation plan
	15 days after meeting	Update to presentation if required by the PM
Program Wide Review Slides	7 days before meeting	Read-ahead package containing the slides that will be presented
	15 days after meeting	Update to presentation if required by PM
Technical Review presentation	2 days before call	Read-ahead package containing slides that will be presented
	10 days after meeting	Update to presentation if required by the PM
Site Visits slides	10 days after meeting	Site visits presentation and any other materials

Deliverable	Due Date	Description
Monthly Financial and Technical Reports	Due the 10th day of the following month	Follow Government provided template for financial reports
Preliminary Design Review (PDR)	7 days before meeting 15 days after meeting	System architecture specification, including key timings, accurate schedule and risk mitigation plan Presentation slides
Critical Design Review (CDR)	7 days before meeting 15 days after meeting	Final architecture specification, Specification of the system hardware design, including key timings, accurate schedule and risk mitigation plan Presentation slides
Hardware Test Plan	Architectural Design: 12 months after program start Detailed Design: 27 months after program start	Plan to verify the functions and timing in the Architectural Design in Phase 1 and the Detailed Design in Phase 2 An analysis report regarding the test coverage must be included in the Phase 2 plan
Application Test Plan	Architectural Design: 12 months after program start	Plan for exercising and measuring the system while executing the Performer's version of the AGILE application software
	Detailed Design: 29 months after program start	Plan for exercising and measuring the system while executing the Performer's version of the AGILE application software
Hardware Test Suite	Architectural Design: 15 months after program start Detailed Design: 34 months after program start	Test vectors/instructions to be used to verify function of the model or design and measure the amount of time required for various operations Test vectors/instructions to be used to verify function of the model or design and measure the amount of time required for various operations
Application Test Suite	Architectural Design: 15 months after program start	Test programs to exercise and measure function and performance of the system with the Performer's optimized version of the AGILE application software and runtime system

Deliverable	Due Date	Description
	Detailed Design: 34 months after program start	Test programs to exercise and measure function and performance of the system with the Performer's optimized version of the AGILE application software and runtime system
Application Framework	Architectural Design: 16 months after program start Detailed Design: 35 months after program start	Framework used to develop AGILE applications
Application Software	Architectural Design: 16 months after program start Detailed Design: 35 months after program start	Performer's version of the AGILE application software which has been optimized for their system
System Model and Designs	2 months prior to end of phase	Architectural Design and documentation for Phase 1 and Detailed Design and documentation for Phase 2
Final Report	2 weeks prior to end of phase	Draft version
	End of Phase	Final version

The timeline for the key program Waypoints, Milestones, and Deliverables for Phases 1 and 2 is shown below in Figure A.3-1 and Figure A.3-2.

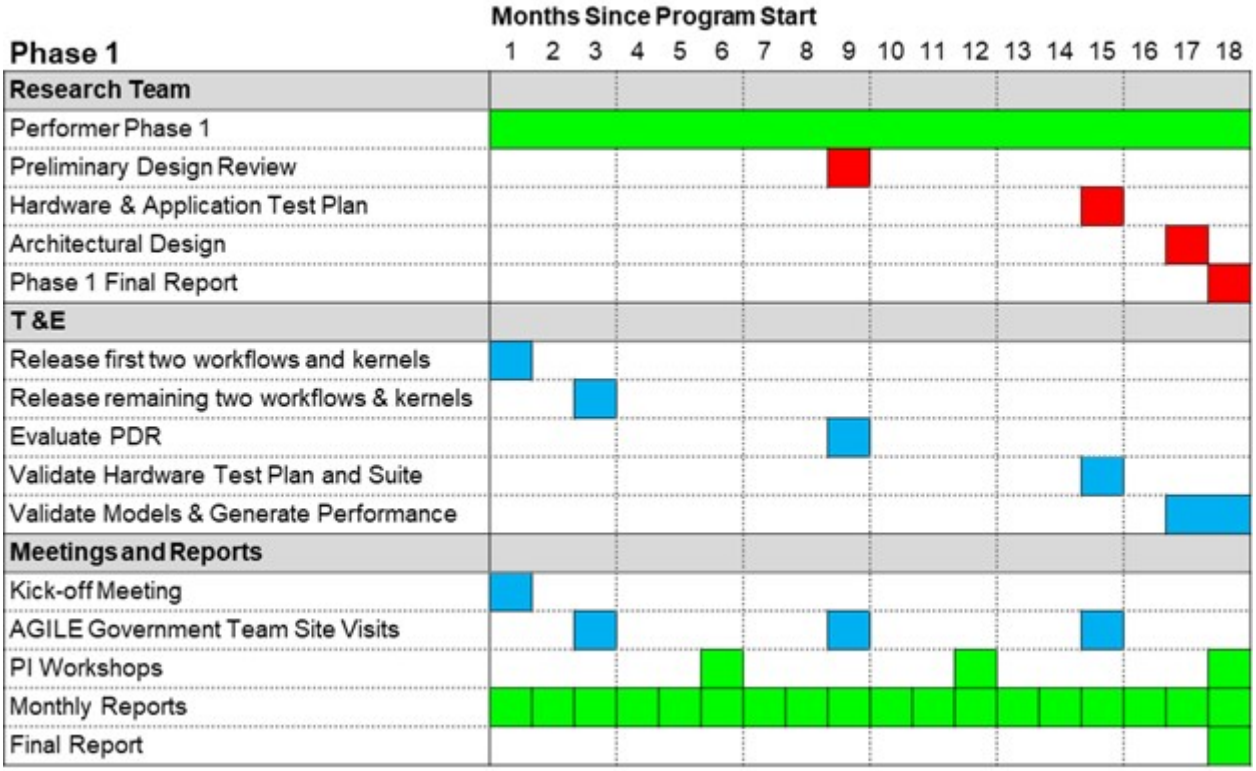

Figure A.3-1 AGILE Phase 1 Timeline

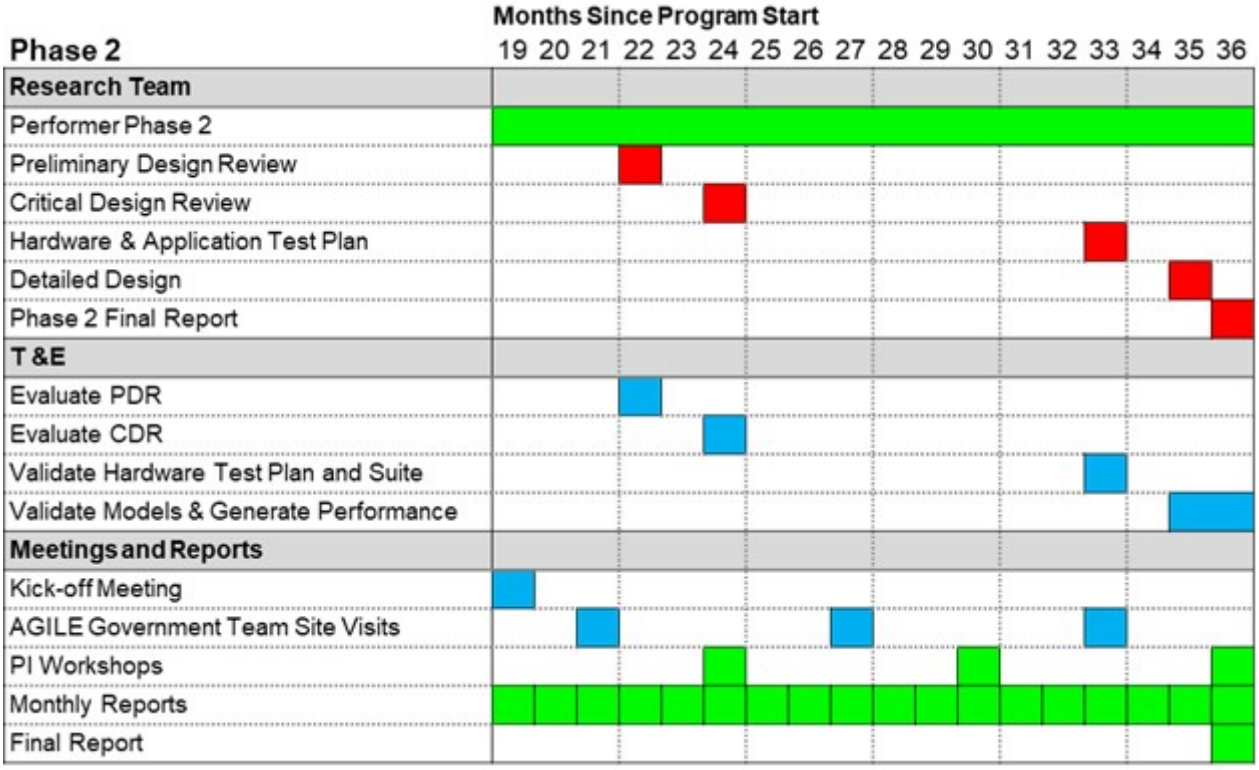

Figure A.3-2 AGILE Phase 2 Timeline

A.4 Meeting and Travel Requirements

Offerors are expected to assume responsibility for administration of their projects and to comply with contractual and program requirements for reporting, attendance at program meetings and workshops, either at their research facility or at another location to be determined by the PM, and availability for site visits. The following paragraphs describe typical expectations for meetings and travel for IARPA/ARO programs as well as the contemplated frequency and locations of such meetings. In addition to ensuring that all necessary details of deliverables are clear and complete, each Performer will be required to be available for questions and troubleshooting from each T&E Team in monthly technical review meetings.

Kickoff and Program Wide Review Meetings

Kickoff and program wide review meetings shall be held at a location to be determined by the PM. For purposes of the proposal, Offerors should assume Washington, D.C. as the location. Performers shall share non-proprietary information and/or updates with the other Performers. Typically, program-wide review meetings, also known as PI Meetings, also include breakout sessions for each team to meet individually with the PM, the program management team, the T&E Team and Government stakeholders. At these breakout sessions, any results the Performers assert are proprietary, such as finances, shall be discussed. Performers shall plan to send no more than 2-3 key technical personal to the program wide review meetings, unless otherwise agreed with the PM. The kickoff meeting is typically held the first month of the program with the Program Wide Review Meetings occurring semi-annually thereafter.

Workshops

The AGILE program intends to hold an initial program workshop in the first month of the program and then similar workshops annually thereafter. The dates and locations of these meetings are to be specified at a later date, but for planning purposes, Offerors should use the approximate time and listed in Table 5 and the location as the Washington, D.C. area. These workshops will typically be two days in duration and will focus on technical aspects of the program and on facilitating open technical exchanges, interaction, and sharing among the various program participants. The first workshop will be a tutorial on operating and modeling requirements for the GFE SST simulator and the first two workflows and benchmarks. Performers may also contact the T&E Team with questions at other times.

A.4.1 Technical Review Meetings

For months when no in-person meetings are scheduled, Performers shall support monthly technical review meetings remotely (e.g., by means of telephone, WebEx, video conference or otherwise, at the discretion of the PM). During these monthly technical review meetings, Performers will present their results, describe their progress toward waypoints and achievement of performance metrics, and identify any issues that may affect their ability to meet metrics, milestones, or overall program objectives as well as answer questions. These meetings will be up to two hours in duration.

A.4.2 Site Visits

Twice per calendar year, the AGILE program management team and invited representatives of Government agencies will visit each Performer at their work site to conduct an in-depth review of progress toward program objectives and to meet with team members. Performers shall host these site visits at the work locations. In additional to presentations and discussions regarding technical progress, details of success and issues, and contributions to the program goals, Performers will be

required provide live and interactive demonstrations, as appropriate. Performers may also be expected to simulate a specific software kernel or micro-kernel selected by the PM. Performers may request time set aside to obtain answers from the T&E Teams to simulation and workflow questions.

A.4.3 Visits to Government Testbeds

For purposes of planning, Offerors should assume the Government A-SST testbed will be located in Albuquerque, NM. This testbed will be used for the independent test and evaluation of the Performers' design and models.

A.4.4 Place of Performance

Performance will be conducted at the Performers' sites with the exception of the tests at the end of each phase which will occur at an IARPA/ARO-sponsored testbed site.

A.4.5 Period of Performance

The AGILE Program is envisioned as a 36-month effort. Phase 1 will last 18 months; and Phase 2 will last 18 months.

B. Federal Award Information

The ACC-APG RTP Division has the authority to award a variety of instruments on behalf of ARO. Anticipated awards will be made in the form of contracts or cooperative agreements. The ACC-APG RTP Division reserves the right to select the type of instrument most appropriate for the effort proposed. Applicants should familiarize themselves with these instrument types and the applicable regulations before submitting a proposal. Following are brief descriptions of the possible award instruments:

1. Procurement Contract. A legal instrument, consistent with 31 U.S.C. 6303, which reflects a relationship between the Federal Government and a state government, a local government, or other entity/contractor when the principal purpose of the instrument is toacquire property or services for the direct benefit or use of the Federal Government.

   Contracts are primarily governed by the following regulations:

   a. Federal Acquisition Regulation (FAR)
   b. Defense Federal Acquisition Regulation Supplement (DFARS)
   c. Army Federal Acquisition Regulation Supplement (AFARS)

2. Cooperative Agreement. 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 recipientwhen 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.

   Cooperative agreements for institutions of higher education, nonprofit organizations, foreign organizations, and foreign public entities 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
d. 32 CFR Parts 21, 22, 26, and 28
e. DoD Research and Development General Terms and Conditions
f. Agency-specific Research Terms and Conditions

Cooperative agreements for for-profit and nonprofit organizations exempted from Subpart E—Cost Principles of 2 CFR Part 200, are primarily governed by the following:

a. Federal statutes
b. Federal regulations
c. 32 CFR Part 34 - Administrative Requirements for Grants and Agreements with For-Profit Organizations
d. 32 CFR Parts 21, 22, 26, and 28
e. DoD Research and Development General Terms and Conditions
f. Agency-specific Research Terms and Conditions

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

a. FAR, DFARS, and AFARS: https://acquisition.gov
b. Code of Federal Regulations (CFR): http://www.ecfr.gov
c. DoD Research and Development General Terms and Conditions: https://www.onr.navy.mil/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions
d. Agency-specific Research Terms and Conditions: http://www.arl.army.mil/www/default.cfm?page=8

C. Eligibility Information

C.1 Eligible Applicants

Eligible applicants under this BAA include institutions of higher education, nonprofit organizations, state and local governments, and for-profit organizations (i.e. large and small businesses) for scientific research. Other Government Agencies, Federally Funded Research and Development Centers, University Affiliated Research Centers (UARCs), Government-Owned, Contractor-Operated facilities, Government Military Academies, and any other similar type of organization that has a special relationship with the Government, that gives them access to privileged and/or proprietary information or access to Government equipment or real property, are not eligible to submit proposals under this BAA or participate as team members under proposals submitted by eligible entities. An entity of which only a portion has been designated as a UARC may be eligible to submit a proposal or participate as a team member subject to an organizational conflict of interest review.

Foreign entities and/or individuals may participate but only as a part of a U.S. based team. The prime contractor must be a U.S. company. Foreign entities and individuals may participate as subcontractors or employees of a U.S. company however, all foreign participation must comply with any necessary Non- Disclosure Agreements, Security Regulations, Export Control Laws, and

other governing statutes applicable under the circumstances. Offerors are expected to ensure that the efforts of foreign participants do not either directly or indirectly compromise the laws of the United States, nor its security interests. As such, both foreign and domestic Offerors should carefully consider the roles and responsibilities of foreign participants as they pursue teaming arrangements.

C.2 Cost Sharing or Matching

There is no requirement for cost sharing, matching, or cost participation to be eligible for award under this BAA. Cost sharing and matching is not an evaluation factor used under this BAA.

In addition, if cost sharing is proposed on a grant or cooperative agreement proposal submitted by a nonprofit or institution of higher education, the award will be subject to the restrictions at 2 CFR 200.306. If cost sharing is proposed on a contract proposal, the awardwill be subject to the restrictions at FAR 35.003.

D. Application and Submission Information

D.1 Address to View Broad Agency Announcement

This BAA may be accessed from the following:

1. Beta SAM (https://beta.sam.gov)
2. Grants.gov (www.grants.gov)
3. ARL website: https://www.arl.army.mil/business/broad-agency-announcements/
4. The IARPA website https://www.iarpa.gov.

Amendments, if any, to this BAA will be posted to these websites when they occur. Interested parties are encouraged to periodically check these websites for updates and amendments.

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

D.2 Content and Form of Application Submission

D.2.1 General Information

A proposal submitted under this BAA must address unclassified fundamental research. Proposal submissions will be protected from unauthorized disclosure in accordance with applicable laws and DoD regulations. Applicants are expected to appropriately mark each page of their submission that contains proprietary information. The participating DoD agencies will provide no funding for direct reimbursement of proposal development costs. Technical and cost proposals (or any other material) submitted in response to this BAA will not be returned. It is the policy of participating DoD agencies to treat all proposals as sensitive, competitive information and to disclose their contents only for the purposes of evaluation.

Post-Employment Conflict of Interest: There are certain post-employment restrictions on former federal officers and employees, including special government employees (Section 207 of Title 18, U.S.C.). If an applicant believes a conflict of interest may exist, the situation should be discussed with AGILE Program Point of Contact listed in Section G: Agency Contacts, who will then coordinate with appropriate ARO/ARL legal personnel prior to having applicant expend time and effort in preparing a proposal.

Statement of Disclosure Preference: Please complete ARO Form 52 or 52A stating your preference for release of information contained in your proposal. Copies of these forms are available at http://www.arl.army.mil/www/default.cfm?page=218#baaforms

NOTE: A proposal may be handled for administrative purposes by support contractors. These support contractors are prohibited from competing on BAA proposals and are bound by appropriate non-disclosure requirements.

Equipment: Normally, title to equipment or other tangible property purchased with Government funds vests with nonprofit institutions of higher education or with nonprofit research organizations if vesting will facilitate scientific research performed for the Government. For profit, organizations are expected to possess the necessary plant and equipment to conduct the proposed research. Deviations may be made on a case-by-case basis to allow commercial organizations to purchase equipment but disposition instructions must be followed.

Questions: IARPA and ARO will accept questions about the BAA until 4:00 PM Eastern Standard Time, December 13th, 2021. Questions about administrative, technical, or contractual issues must be submitted to the BAA email address at dni-iarpa-AGILE-BAA-2021@iarpa.gov. All requests must include the name, e-mail address (if available), and phone number of a point of contact for the requested information. A consolidated Question and Answer response will be posted every few days on the IARPA website, http://www.iarpa.gov/index.php/research-programs/agile; no answers will go directly to the submitter. Do not send questions with proprietary content.

D.2.2 Preparing an Application

This format applies to all proposals submitted via email. Offerors' proposals should show the location of each section of the proposal, as well as major subdivisions of the project description. Forms are available at http://www.arl.army.mil/www/default.cfm?page=218#baaforms.

COVER PAGE ARO FORM 51:

1. A Cover Page is required. Proposals will not be processed without either: (1) a signed Cover Page, ARO Form 51, or (2) an SF 424 R & R Form
2. Should the project be carried out at a branch campus or other component of the submitting organization, that branch campus or component should be identified in the space provided (Block 11 on the ARO Form 51 and Block 12 on the SF424 R&R).
3. The title of the proposed project should be brief, scientifically representative, intelligible to a scientifically literate reader, and suitable for use in the public domain.
4. The proposed duration for which support is requested should be consistent with the program duration of thirty six (36) months.
5. To evaluate compliance with Title IX of the Education Amendments of 1972 (20 U.S.C. A§ 1681 Et. Seq.), the Department of Defense is collecting certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in STEM disciplines. To enable this assessment, each application must also include the following forms completed as indicated:
   a. **Research and Related Senior/Key Person Profile (Expanded) form:** The Degree Type and Degree Year fields on the Research and Related Senior/Key Person Profile (Expanded) form will be used by DoD as the source for career information. In addition to the required fields on the form, applicants must complete these two fields for all

individuals that are identified as having the project role of PD/Pl or Co-PD/Pl on the form. Additional senior/key persons can be added by selecting the "Next Person" button.

b. **Research and Related Personal Data form:** This form will be used by DoD as the source of demographic information, such as gender, race, ethnicity, and disability information for the Project Director/Principal Investigator and all other persons identified as Co-Project Director{s)/Co-Principal Investigator(s). Each application must include this form with the name fields of the Project Director/Principal Investigator and any Co-Project Director(s)/Co-Principal Investigator(s) completed; however, provision of the demographic information in the form is voluntary. If completing the form for multiple individuals, each Co-Project Director/Co-Principal Investigator can be added by selecting the "Next Person" button. The demographic information, if provided, will be used for statistical purposes only and will not be made available to merit reviewers. Applicants who do not wish to provide some or all of the information should check or select the "Do not wish to provide" option.

6. Pursuant to 31 U.S.C. 7701, as amended by the Debt Collection Improvement Act of 1996 [Section 31001(I) (1), Public Law 104-134], federal agencies shall obtain each awardees' Taxpayer Identification Number (TIN). This number may be the Employer Identification Number for a business or non-profit entity or the Social Security Number for an individual. The TIN is being obtained for purposes of collecting and reporting on any delinquent amounts that may arise out of an awardees' relationship with the Government.
7. Offerors shall provide their organization's Unique Entity Identifier (formerly DUNS). This number is a nine-digit number assigned by Dun and Bradstreet Information Services. See Section II.D.3 of this BAA for requirements pertaining to the Unique Entity Identifier.
8. Offerors shall provide their assigned Commercial and Government Entity (CAGE) Code. The CAGE Code is a 5-character code assigned and maintained by the Defense Logistics Service Center (DLSC) to identify a commercial plant or establishment.

TABLE OF CONTENTS: Offerors' proposals should show the location of each section of the proposal, as well as major subdivisions of the project description. Use the following format for the proposal table of contents.

SECTION	PAGE NUMBER
Table of Contents	A-1
Statement of Disclosure Preference (Form 52 or 52A)	B-1
Research & Related Other Project Information	B-2
Project Abstract	C-1
Project Description (Technical Proposal)	D-1 - D-□
Biographical Sketch	E-1 - E-□
Bibliography	F-1 - F-□
Current and Pending Support	G-1 - G-□
Facilities, Equipment, and Other Resources	H-1 - H-□
Proposal Budget	I-1 - I-□
Contract Facilities Capital Cost of Money (DD Form 1861)	J-1
Appendices	K-□
List Appendix Items: _	

STATEMENT OF DISCLOSURE PREFERENCE (FORM 52 OR 52A): Complete and sign ARO Form 52 (Industrial Contractors) or ARO Form 52A (Educational and Nonprofit Organizations), form can be found at the following website: http://www.arl.army.mil/www/default.cfm?page=218.

RESEARCH AND RELATED Other Project Information: The form entitled "Research and Related Other Project Information" found at the following website: http://www.arl.army.mil/www/default.cfm?page=218, shall be completed and signed by all organizations.

PROJECT ABSTRACT:

1. The Project Abstract shall be completed on the form entitled "Publicly Releasable Abstract" found at the following website: http://www.arl.army.mil/www/default.cfm?page=218.
2. Unless otherwise instructed in this BAA, the Project Abstract shall include a concise statement of work and basic approaches to be used in the proposed effort. The abstract should include a statement of scientific objectives, methods to be employed, and the significance of the proposed effort to the advancement of knowledge.
3. The abstract should be no longer than one (1) page (maximum 4,000 characters).
4. The project abstract shall be marked by the applicant as publicly releasable. By submission of the project abstract, the applicant confirms that the abstract is releasable to the public.

TECHNICAL PROPOSAL (PROJECT DESCRIPTION): The technical portion of the proposal shall be no longer than 25 pages including tables and figures, single spaced text, size 12 Times New Roman font with one inch page margins, and shall contain the following:

1. Technical Approach: Introduce the problem to be addressed, survey related work, identify key obstacles, and outline the proposed solution that address the program goals and metrics described in A2.3. Proposals should clearly address the expected key challenges and proposed methods to overcome these difficulties taking into consideration the current state of field. The proposed approach shall include:
    a. Description of the Offerors' perspective of the data challenges that the proposed architecture will overcome.
    b. Description of the proposed system-level intelligent mechanisms for processing, moving, accessing, and storing large, unstructured, time-varying data streams and structures that allow for the scalable and efficient execution of dynamic graph analytic workflows.
    c. Description of the Offerors' key architectural innovations.
    d. Conceptual AGILE architecture specification.
    e. Description of the proposed research for overcoming the technical challenges provided in Section A.2.1.
    f. Description of how the design will enable system security as it is specified in the BAA. How will these features be tested and evaluated. How will the Offerors test and evaluate the architecture at a system-level.
    g. Description of the proposed runtime system and the methodology for testing the runtimes.

h. Description of the impact of the proposed architecture on the programming environment.
i. A description of how the Offeror will support the co-design process for developing the Architectural Design and Detailed Design.
j. A plan for how the Architectural Design and Detailed Design will be tested by the Offeror.
k. Description of the risks associated with the proposed project and plans for mitigating these risks.
l. Description of the Offeror's development and design process, specially providing the methodology for modeling the node and system-level architectures.
m. Description of the critical IP that will be utilized in proposed architecture that isn't funded by the AGILE Program. The description should provide relevant performance characteristics and the risk associated with the use of the IP in the architecture.
n. Initial estimation of the performance metrics provided in Section A.2.3.

2. Project Schedule, Milestones, and Deliverables: Program milestones are described in A.2.3. Program schedule and deliverables are described in A.3. In addition, proposers should set aggressive yearly quantitative milestones that define their proposed path toward the end-of-the-program goals
3. Management Approach: A discussion of the overall approach to the management of this effort, including brief discussions of: required facilities; relationships with any subawardees and with other organizations; availability of personnel; and planning, scheduling, and control procedures. A brief description of your organization, including if the Offeror has extensive government contracting experience.
4. The names of other federal, state, local agencies, or other parties receiving the proposal and/or funding the proposed effort. If none, so state. Concurrent or later submission of the proposal to other organizations will not prejudice its review by the ARL/ARO if we are kept informed of the situation.
5. The type of additional support, if any, requested (e.g., facilities, equipment, and materials). GFI/GFE that will be available to all proposers is described in A.2.4.

BIOGRAPHICAL SKETCHES:

1. This Section shall contain the biographical sketches for senior and key personnel only.
   a. Primary Principal Investigator: The "Primary" PI provides a single or initial point of communication between the sponsoring agency(s) and the awardee organization(s) about scientific matters. If not otherwise designated, the first PI listed will serve as the "Primary" PI. This individual can be changed with approval of the agency. The sponsoring agency(s) does not infer any additional scientific stature to this role among collaborating investigators.
   b. Co-Principal Investigators: The individual(s) a research organization designates as having an appropriate level of authority and responsibility for the proper conduct of the research and submission of required reports to the agency. When an organization designates more than one PI, it identifies them as individuals who share the authority and responsibility for leading and directing the research, intellectually and logistically. The sponsoring agency(s) does not infer any distinction among multiple PIs.

c. Key personnel: The individual(s) a research organization designates as having a high level of technical expertise in the topics proposed to be researched and who will both play an active role in the research and supervise the work of more junior personnel on a daily basis.

2. The following information is required:
   a. Relevant experience and employment history including a description of any prior Federal employment within one year preceding the date of proposal submission.
   b. List of up to five (5) publications most closely related to the proposed project and up to five (5) other significant publications, including those being printed. Patents, copyrights, or software systems developed may be substituted for publications.
   c. The time commitment of each senior or key person to this project.
3. For the personnel categories of postdoctoral associates, other professionals, and students (research assistants), the proposal may include information on exceptional qualifications of these individuals that merit consideration in the evaluation of the proposal.
4. The biographical sketches are limited to three (3) pages per investigator and other individuals that merit consideration.

BIBLIOGRAPHY: A bibliography of pertinent literature is required. Citations must be complete, including full name of author(s), title, and location in the literature. The bibliography is not considered part of the page count.

CURRENT AND PENDING SUPPORT:

1. All project support from whatever source must be listed. The list must include all projects requiring a portion of the principal investigator's and other senior personnel's time, even if they receive no salary support from the project(s) including Cooperative Research and Development Agreements (CRADAs) or other technology transfer agreements with federal labs. Funding provided under any award resulting from this BAA may only be used in support of the effort funded by that award, and not for any other project or purpose.
2. The information should include, as a minimum:
   a. Project/proposal title and brief description,
   b. Name and location of the organization or agency presently funding the work or requested to fund such work,
   c. Award amount or annual dollar volume of the effort,
   d. Period of performance, and
   e. Breakdown of the time required of the principal investigator and/or other senior personnel.

FACILITIES, EQUIPMENT, AND OTHER RESOURCES: The Offeror should include in the proposal a listing of facilities, equipment, and other resources already available to perform the research proposed.

BUDGET PROPOSAL (DD FORM 1861):

1. Each proposal must contain a budget for each year of support requested and a cumulative budget for the full term of requested support. The budget form (Form 99) may be reproduced as needed. Locally produced versions may be used, but you may not make substitutions in prescribed budget categories nor alter or rearrange the cost categories as they appear on the form. The proposal may request funds under any of the categories listed so long as the item is

considered necessary to perform the proposed work and is not precluded by applicable cost principles. Additionally, a budget by major proposed research tasks using the same budget categories must be included.

2. A signed summary budget page must be included. The documentation pages should be titled "Budget Explanation Page" and numbered chronologically starting with the budget form. The need for each item should be explained clearly.
3. All cost data must be current and complete. Costs proposed must conform to the following principles and procedures:

   Educational Institutions: 2 Code of Federal Regulations (CFR) Part 200 (formerly OMB Circular A-21) Nonprofit Organizations: 2 CFR Part 200 (formerly OMB Circular A-122*) Commercial Organizations: FAR Part 31, DFARS Part 231, FAR Subsection 15.403-5, and DFARS Subsection 215.403-5.

   *For those nonprofit organizations specifically exempt from the provisions of 2 CFR Part 230, FAR Part 31 and DFARS Part 231 shall apply.

4. Sample itemized budgets and the information they must include for a contract can be found at Section II.H. (Other Information). Before award it must be established that an approved accounting system and financial management system exist.

APPENDICES: Some situations require that special information and supporting documents be included in the proposal before funding can be approved. Such information and documentation should be included by appendix to the proposal.

D.2.3 Submission of Complete Research Proposals

Proposals must be submitted through the Offeror's organizational office having responsibility for Government business relations. All signatures must be that of an official authorized to commit the organization in business and financial affairs. Proposals must be submitted electronically using email. Proposals must be submitted electronically using one of the two following formats, based on award type sought. The content will remain the same whether using email or Grants.gov.

EMAIL SUBMISSION (for Contracts only):

1. Proposal requesting award of a **CONTRACT** must be emailed directly to **usarmy.rtp.devcom-arl.mbx.baa4@army.mil**. Do not email full proposals to the AGILE Program Point of Contact. All e-mailed proposals must contain the information outlined in Section II.D.2, entitled "*Table of Contents*" including the electronic forms as follows:
   a. ARO Form 51, Proposal Cover Page;
   b. ARO Form 99, Summary Proposal Budget or equivalent,
   c. ARO Current and Pending Support (unnumbered form),
   d. ARO Form 52 or ARO Form 52a.
   e. "FAR 52.209-11 – Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016). See Note below."

   These forms may be accessed at http://www.arl.army.mil/www/default.cfm?page=218#forms under BAA Forms. The fillable PDF forms may be saved to a working directory on a computer and opened and filled in using the latest compatible Adobe Reader software application found

at this Grants.Gov: https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html

Note: A completed 52.209-11 – Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016), is not required if the Offeror's System for Award Management (SAM) Certifications and Representations have been updated since March 2016. If the Offeror's SAM has not be updated since March 2016, the completed representation must be submitted and include POC information and signature of the authorized representative.

2. All forms requiring signature must be completed, printed, signed, and scanned into a PDF document. All documents must be combined into a single PDF formatted file to be attached to the e-mail.
3. Proposal documents (excluding required forms) must use the following format:
   - Page Size – 8 ½ x 11 inches
   - Margins – 1 inch
   - Spacing – single
   - Font – Times New Roman, 12 point, single-sided pages

GRANTS.GOV SUBMISSION (For all Assistance Instruments- Cooperative Agreements):

1. Grants.gov Registration (See Section II.D.2. f. Grants.gov Registration below) must be accomplished prior to application through this process. Note- All web links referenced in this section and "Grants.gov Registration" (below) are subject to change by grants.gov and may not be updated here.

2. Specific forms are required for submission of a proposal. The forms are contained in the Application Package available through the Grants.gov application process. To access these materials, go to https://www.grants.gov/web/grants/applicants/apply-for-grants.html select "Apply", and then select "Get Application Package." A Grant Application Package and Application Instructions are available for through the Grants.Gov Apply portal under CFDA Number 12.431/Funding Opportunity Number W911NF-22-S-0001-01. Select "Apply" and then "Apply Now Using Workspace." The following documents are mandatory: (1) Application for Federal Assistance (Research and Related) (SF 424 (R&R), and (2) Attachments form.

(a) The SF 424 (R&R) form is to be used as the cover page for all proposals.

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), proposers are providing the certification required by 32 CFR Part 28 regarding lobbying. The SF 424 (R&R) must be fully completed.

(b) The Attachments form must contain the information outlined in Section II, D, 2 (b. Preparing an Application), entitled "Table of Contents" of this BAA including the electronic forms as follows:

(1) Research and Related Other Project Information;

(2) ARO Form 99, Summary Proposal Budget;

(3) ARO Current and Pending Support (unnumbered form)

(4) Representation by Corporations Regarding conviction of a Felony Criminal Violation under any Federal or State Law and Representation by Corporations Regarding an Unpaid Delinquent Tax Liability

Items (1)-(4) forms may be accessed at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/ Item (4) "Representation relating to Tax Liability and Felony Convictions" may be submitted on a word document and attached to available field within the attachments form. The fillable PDF forms may be saved to a working directory on a computer and opened and filled in using the latest compatible Adobe Reader software application found at this Grants.Gov: https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html

Note: Representation by Corporations Regarding Conviction of a Felony Criminal Violation and Unpaid Delinquent Tax Liability require POC information and signature of the authorized representative.

(c) All documents must be combined into separate and single PDF formatted files titled using the Table of Contents names listed in "Section II.D.2.b. Preparing an Application": Preparation of complete Research Proposals". Include "W911NF-22-S-0001-01" in title so the proposal will be distinguished from other BAA submissions and upload using the mandatory Attachments form.

(d) The training demonstration at https://www.grants.gov/web/grants/applicants/applicant-training.html will assist AORs in the application process. Remember that you must open and complete the Application for Federal Assistance (Research and Related) (SF 424 (R&R)) first, as this form will automatically populate data fields in other forms. If you encounter any problems, contact customer support at 1-800-518-4726 or at https://www.grants.gov/web/grants/support.html. If you forget your user name or password, follow the instructions provided in the Credential Provider tutorial. Tutorials may be printed by right-clicking on the tutorial and selecting "Print".

(e) As it is possible for grants.gov to reject the proposal during this process, it is strongly recommended that proposals be uploaded at least two days before any established deadline in the BAA so that they will not be received late and be ineligible for award consideration. It is also recommended to start uploading proposals at least two days before the deadline to plan ahead for any potential technical and/or input problems involving the applicant's own equipment.

(f) Grants.Gov Registration

Registration. Each organization that desires to submit applications via Grants.Gov must complete a one-time registration. There are several one-time actions your organization must complete in order to submit applications 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, register with Grants.gov and obtain approval for an Authorized Organization Representative (AOR) to submit applications on behalf of the organization). To registered please see

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

Please note the registration process for an Organization or an Individual can take between three to five business days or as long as four weeks if all steps are not completed in a timely manner.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process should be directed to Grants.gov at 1-800-518-4726 or https://www.grants.gov/web/grants/support.html.

D.3 Unique Entity Identifier and System for Award Management (SAM)

Each applicant (unless the applicant is an individual or Federal awarding agency that is excepted from those requirements under 2 CFR §25.110(b) or (c), or has an exception approved by the Federal awarding agency under 2 CFR §25.110(d)) is required to:

1. Be registered in SAM before submitting its application;
2. Provide a valid unique entity identifier in its application; and
3. Continue to maintain an active SAM registration with current information at all times during which it has an active Federal award or an application or plan under consideration by a Federal awarding agency.

The Federal awarding agency may not make a Federal award to an applicant until the applicant has complied with all applicable unique entity identifier and SAM requirements. If an applicant has not fully complied with the requirements by the time the Federal awarding agency is ready to make a Federal award, the Federal awarding agency may determine that the applicant is not qualified to receive a Federal award and use that determination as a basis for making a Federal award to another applicant.

D.4 Submission Dates and Times

Proposals:

Proposals transmitted to be considered for award must be received **no later than 4:00 PM Eastern Standard Time on January 24th, 2022.**

Applicants are responsible for submitting electronic proposals in sufficient time to insure Grants.gov receives it by the time specified in this BAA. If the electronic proposal is received by Grants.gov after the exact time and date specified for receipt of offers, it will be considered "late" and will not be considered for award. Acceptable evidence to establish the time of receipt by Grants.gov includes documentary evidence of receipt maintained by Grants.gov.

Because of potential problems involving the applicants' own equipment, to avoid the possibility of late receipt and resulting in ineligibility for award consideration, it is strongly recommended that proposals be uploaded at least two business days before the deadline established in the BAA.

If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at sam.gov by the exact time specified in the solicitation, and urgent Government requirements preclude amendment of the solicitation closing date, the time specified for receipt of proposals will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

Proposal Receipt Notices – After a proposal is submitted to Grants.gov, the AOR will receive a series of three emails from Grants.gov. The first two emails will be received within 24 to 48 hours after submission. The first email will confirm time of receipt of the application by the Grants.gov system and the second will indicate that the application has either been successfully validated by the system prior to transmission to the grantor agency or has been rejected due to errors. A third

email will be received once the agency has confirmed receipt of the proposal. The document titled "Tracking Your Application Package", located at the website below explains this process. (https://www.grants.gov/web/grants/applicants/track-my-application.html?inheritRedirect=true). The proposal is not considered received until the AOR receives email #3.

D.5 Intergovernmental Review

Not Applicable

D.6 Funding Restrictions

Multiple awards are anticipated. The actual amount of each award will be contingent on availability of funds and the scope of the proposed work. Depending on the results of the proposal evaluation, there is no guarantee that any of the proposals submitted will be recommended for funding.

D.7 Other Submission Requirements

Information to be requested from successful Offerors: - Offerors whose proposals are accepted for funding will be contacted before award to provide additional information required for award. The required information is normally limited to clarifying budget explanations, representations, certifications, and some technical aspects.

For Contracts Only- Performance Work Statements (PWS) - prior to award the Contracting Officer may request that the contractor submit a PWS for the effort to be performed, which will be incorporated into the contract at the time of award.

An applicant may withdraw a proposal at any time before award by written notice or by email. Notice of withdrawal shall be sent to the Contracting Officer identified in Section G, of this BAA. Withdrawals are effective upon receipt of notice by the Contracting/Grants Officer.

E. Application Review Information

E.1 Criteria

IARPA/ARO shall only review proposals against the evaluation criteria, program balance, and availability of funds, and shall not evaluate them against other proposals, since they are not submitted in accordance with a common work statement. For evaluation purposes, a proposal is the document described in Section II.D.2.2 of the BAA. Other supporting or background materials submitted with the proposal shall not be considered. Only Government personnel shall make evaluation and award determinations under this BAA

The factors used to evaluate and select proposals for negotiation for this Program BAA are described in the following paragraphs. Each proposal shall be evaluated on its own merits and its relevance to the Program goals rather than against other proposals submitted in response to this BAA. The proposals shall be evaluated on the basis of technical strength, as determined by the technical criteria described below, of the proposal and funding availability factors. Within the technical evaluation factor, the specific technical criteria are listed and weighting of importance are identified as follows:

- Overall Scientific and Technical Merit
    - Greater importance – equal weight between Overall Scientific and Technical Merit and Effectiveness of Proposed Work Plan
- Effectiveness of Proposed Work Plan

    - Greater importance – equal weight between Overall Scientific and Technical Merit and Effectiveness of Proposed Work Plan
- Contribution and Relevance to the IARPA and ARO Mission and Program Goals
    - Lesser importance – equal weight between Contribution and Relevance to the IARPA and ARO Mission and Program Goals, Relevant Experience and Expertise, and Resource Realism.
- Relevant Experience and Expertise
    - Lesser importance – equal weight between Contribution and Relevance to the IARPA and ARO Mission and Program Goals, Relevant Experience and Expertise, and Resource Realism.
- Resource Realism
    - Lesser importance – equal weight between Contribution and Relevance to the IARPA and ARO Mission and Program Goals, Relevant Experience and Expertise, and Resource Realism.

Specifics about the evaluation criteria are provided below.

Award(s) shall be made to an Offeror on the basis of the technical and funding availability factors listed below, and subject to successful negotiations with the Government. Award shall not be made to Offeror(s) whose proposal(s) are determined not to be selectable. Offerors are cautioned that failure to follow submittal instructions may negatively impact their proposal evaluation or may result in rejection of the proposal for non-compliance

E.1.1 Overall Scientific and Technical Merit

Overall scientific and technical merit of the proposal is substantiated, including unique and innovative methods, approaches, and/or concepts. The Offeror clearly articulates an understanding of the problem to be solved. The technical approach is credible, and includes a clear assessment of primary risks and a means to address them. The proposed research advances the state-of-the-art.

E.1.2 Effectiveness of Proposed Work Plan

The feasibility and likelihood that the proposed approach shall satisfy the Program's milestones and metrics are explicitly described and clearly substantiated along with risk mitigation strategies for achieving stated milestones and metrics. The proposal reflects a mature and quantitative understanding of the Program milestones and metrics, and the statistical confidence with which they may be measured. Any Offeror-proposed milestones and metrics are clear and well-defined, with a logical connection to enabling Offeror decisions and/or Government decisions. The schedule to achieve the milestones is realistic and reasonable.

The roles and relationships of prime and sub-contractors is clearly delineated with all participants fully documented. Work plans shall demonstrate the ability to provide full Government visibility into and interaction with key technical activities and personnel, and a single point of responsibility for contract performance. Work plans shall also demonstrate that key personnel have sufficient time committed to the Program to accomplish their described Program roles.

The requirement and rationale for and the anticipated use or integration of Government resources, including but not limited to all equipment, facilities, information, etc., is fully described including dates when such Government Furnished Property (GFP), Government Furnished Equipment

(GFE), Government Furnished Information (GFI) or other similar Government-provided resources shall be required.

The Offeror's proposed intellectual property and data rights are consistent with the Government's need to be able to effectively manage the program and evaluate the technical output and deliverables, communicate program information across Government organizations and support transition and further use and development of the program results to Intelligence Community users at an acceptable cost. The proposed approach to intellectual property rights is in the Government's best interest.

E.1.3 Contribution and Relevance to the IARPA and ARO Mission and Program Goals

The proposed solution meets the letter and intent of the stated program goals and all elements within the proposal exhibit a comprehensive understanding of the problem. The Offeror clearly addresses how the proposed effort shall meet and progressively demonstrate the Program goals. The Offeror describes how the proposed solution contributes to IARPA's mission to invest in high-risk/high-payoff research that can provide the U.S. with an overwhelming intelligence advantage.

E.1.4 Relevant Experience and Expertise

The Offeror's capabilities, related experience, facilities, techniques, or unique combination of these, which are integral factors for achieving the proposal's objectives as well as qualifications, capabilities, and experience of the proposed principal investigator, team leader, and key personnel critical in achieving the proposal objectives. Time commitments of key personnel must be sufficient for their proposed responsibilities in the effort.

E.1.5 Resource Realism

The proposed resources demonstrates a clear understanding of the project, a perception of the risks and the ability to organize and perform the work. The labor hours and mix are consistent with the technical and management proposal and are realistic for the work proposed. Material, equipment, software, data collection and management, and travel, especially foreign travel, are well justified, reasonable, and required for successful execution of the proposed work.

E.2 Review and Selection Process

NOTE: A proposal may be handled for administrative purposes by support contractors. These support contractors are prohibited from competing on BAA proposals and are bound by appropriate non-disclosure requirements.

Given the broad, ambitious, and complex nature of the AGILE program, the number of Government personnel who have "hands-on" expertise or in-depth knowledge related to each proposal may be limited. Within the Office of the Director of National Intelligence (ODNI), there may be an insufficient number of available experts to evaluate proposals. As such, it may be necessary to enlist Proposal Reviewers from Other Government Agencies (OGAs) that have related expertise and vested interests in the BAA technology areas, as well as Non-Government technical experts including Federally Funded Research and Development Center (FFRDC) resources to serve as Non-Government Advisors. All OGA Proposal Reviewers will have advised their home organizations and supervisors of their involvement in the specific AGILE proposal review and confirm to ARO that their home organization is aware of and has approved their participation and that any necessary agreements are in place (e.g., inter-agency agreement, MOU,

etc.). Similarly, IARPA will ensure that appropriate approvals and agreements are in place to engage Non-Government Advisors to provide these advisory services.

The Government may use Non-Government contractors who are employees of Booz Allen Hamilton, Whitney, Bradley & Brown, Inc. (WBB), Patriot Solutions Group, Airlin Technologies, Bluemont Technology and Research, Navstar, Crimson Phoenix, Northwood Global Solutions, Onts & Quants, Inc., Quantitative Scientific Solutions, Quantitative Scientific Solutions (QS-2), SAIC, Tarragon Solutions, and subject matter experts from the DOE and DOD National Laboratories to provide expert advice regarding portions of the proposals submitted to the Government and to provide logistical support in carrying out the evaluation process. In addition to supporting evaluations, the following entities: The Department of Energy Sandia National Laboratories, Pacific Northwest National Laboratory, and Lawrence Berkeley National Laboratory will be supporting T&E activities for contracts awarded under this program and should be considered as part of an Offeror's OCI disclosure. These personnel shall have signed and are subject to the terms and conditions of non- disclosure agreements. By submission of its proposal, an Offeror agrees that its proposal information may be disclosed to employees of these organizations for the limited purpose stated above. Offerors who object to this arrangement shall provide clear notice of their objection as part of their transmittal letter. If Offerors do not send notice of objection to this arrangement in their transmittal letter, the Government shall assume consent to the use of contractor support personnel in assisting the review of submittal(s) under this BAA. Only Government personnel shall make evaluation and award determinations under this BAA.

E.3 Recipient Qualification

a. For Cooperative Agreement:

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:

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

(a) 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);

(b) 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;

(c) 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 §200.205 Federal awarding agency review of risk posed by applicants.

b. For Assistance awards recipients will be required to submit the following representation prior to award:

Representations under DoD Assistance Agreements: Appropriations Provisions on Tax Delinquency and Felony Convictions

The applicant is ( ) is not ( ) a "Corporation" meaning any entity, including any institution of higher education, other nonprofit organization, or for-profit entity that has filed articles of incorporation.

If the applicant is a "Corporation" please complete the following representations:

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

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

The "Representation relating to Tax Liability and Felony Convictions", the form may be accessed at https://www.arl.army.mil/business/broad-agency-announcements/baa-forms/.

NOTE: If an applicant responds in the affirmative to either of the above representations, the applicant is ineligible to receive an award unless the agency suspension and debarment official (SDO) has considered suspension or debarment and determined that further action is not required to protect the Government's interests. The applicant therefore should provide information about its tax liability or conviction to the agency's

SDO as soon as it can do so, to facilitate completion of the required considerations before award decisions are made. Applicant's authorized representative must sign and date form.

c. For CONTRACT Proposals:

(i) The Federal Awardee Performance and Integrity Information System (FAPIIS) will be checked prior to making an award. The web address is: https://www.fapiis.gov/fapiis/#/home. The applicant representing the entity may comment in this system on any information about itself that a Federal Government Official entered. The information in FAPIIS will be used in making a judgment about the entity's integrity, business ethics, and record of performance under Federal awards that may affect the official's determination that the applicant is qualified to receive an award.

(ii) For contracts, the following representation must be submitted prior to award if the Offeror's SAM Representations and Certifications are not dated after March 2016. If the Offeror's SAM Representations and Certifications have been updated after March 2016, this representation is not required to be submitted separately.

FAR 52.209-11: Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016)

(a) As required by sections 744 and 745 of Division E of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L 113-235), and similar provisions, if contained in subsequent appropriations acts, the Government will not enter into a contract with any corporation that--

(1) Has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless an agency has considered suspension or debarment of the corporation and made a determination that suspension or debarment is not necessary to protect the interests of the Government; or

(2) Was convicted of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless an agency has considered suspension or debarment of the corporation and made a determination that this action is not necessary to protect the interests of the Government.

(b) The Offeror represents that—

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

(2) It is [ ] is not [ ] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

F. Award Administration Information

F.1 Award Notices

Initial notification of selection of proposals for funding will be e-mailed by ARO to successful Offerors. Unsuccessful Offerors will be notified shortly thereafter.

The notification e-mail must not be regarded as an authorization to commit or expend funds. The Government is not obligated to provide any funding until a Government Contracting Officer signs the contract award document.

Applicants whose proposals are recommended for negotiation of award will be contacted by a Contract Specialist to discuss additional information required for award. This may include representations and certifications, revised budgets or budget explanations, certificate of current cost or pricing data, subcontracting plan for small businesses, and other information as applicable to the proposed award.

F.2 Administrative and National Policy Requirements

F.2.1 Required Certifications

(i) For CONTRACT Proposals:

Certifications Required for Contract Awards. Certifications and representations shall be completed by successful Offerors prior to award. Federal Acquisition Regulation (FAR) Online Representations and Certifications are to be completed through SAM at website https://www.SAM.gov. Defense FAR Supplement and contract specific certification packages will be provided to the contractor for completion prior to award.

FAR 52.203-18, PROHIBITION ON CONTRACTING WITH ENTITIES THAT REQUIRE CERTAIN CONFIDENTIALITY AGREEMENTS OR STATEMENTS—

REPRESENTATION (JAN 2017)

(ii) For GRANT and COOPERATIVE AGREEMENT Proposals:

Grant awards greater than $100,000 require a certification of compliance with a national policy mandate concerning lobbying. Statutes and Government-wide regulations require the certification to be submitted prior to award. The certification is set forth at Appendix A to 32 CFR 28 regarding lobbying. When submitting your grant through Grants.gov, by completing blocks 18 and 19 of the Standard Form 424 Research and Related (R&R) Form, the grant applicant is providing the

certification on lobbying required by 32 CFR Part 28, otherwise a signed copy by the authorized representative must be provided. Below is the required certification:

(a). CERTIFICATION AT APPENDIX A TO 32 CFR PART 28 REGARDING LOBBYING: Certification for Contracts, Grants, Loans, and Cooperative Agreements The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

(b). PROHIBITION ON CONTRACTING WITH ENTITIES THAT REQUIRED CERTAIN INTERNAL CONFIDENTIALITY AGREEMENTS – REPRESENTATION

Agreement with the representation below will be affirmed by checking the “I agree” box in block 17 of the SF424 (R&R) as part of the electronic proposal submitted via Grants.gov. The representation reads as follows:

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

Note that: (1) the basis for this representation is a prohibition in section 743 of the Financial Services and General Government Appropriations Act, 2015, Pub. L. 113-235) on provision of

funds through grants and cooperative agreements to entities with certain internal confidentiality agreements or statements; and 2) section 743 states that it does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(c.) PROHIBITION ON CONTRACTING WITH ENTITIES USING CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT

Section 889 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2019 (Public Law 115-232) prohibits the head of an executive agency from obligating or expending loan or grant funds to procure or obtain, extend, or renew a contract to procure or obtain, or enter into a contract (or extend or 105 renew a contract) to procure or obtain the equipment, services, or systems prohibited systems as identified in section 889 of the NDAA for FY 2019. For more information on how this applies to all grant recipients and sub-recipients after August 13, 2020, please see DoD Research General Terms and Conditions (SEP 2020) NP Article IV. Other national policy requirements, paragraph 18.

F.2.2 Policy Requirements

BIOLOGICAL DEFENSE SAFETY PROGRAM REQUIREMENTS: Successful Offerors whose Principal Investigators are conducting research with Bio-safety Levels 3 and 4 material must prepare a Facility Safety Plan in accordance with 32 CFR 626.18. See URL: https://www.gpo.gov/fdsys/search/pagedetails.action?collectionCode=CFR&searchPath=Title+32%2FChapter+V%2FSubchapter+H%2FPart+626&granuleId=CFR-2002-title32-vol3-part626&packageId=CFR-2002-title32-vol3&oldPath=Title+32%2FChapter+V%2FSubchapter+H%2FPart+626&fromPageDetails=true&collapse=false&ycord=2178 for a copy of 32 CFR 626.18, Biological Defense Safety Program.

MILITARY RECRUITING: For Assistance Instruments Only. This is to notify potential Offerors that each grant or cooperative agreement awarded under this announcement to an institution of higher education must include the following term and condition:

"As a condition for receipt of funds available to the Department of Defense (DOD) under this award, the recipient agrees that it is not an institution of higher education (as defined in 32 CFR part 216) that has a policy of denying, and that it is not an institution of higher education that effectively prevents, the Secretary of Defense from obtaining for military recruiting purposes: (A) entry to campuses or access to students on campuses or (B) access to directory information pertaining to students. If the recipient is determined, using the procedures in 32 CFR part 216,

to be such an institution of higher education during the period of performance of this agreement, and therefore to be in breach of this clause, the Government will cease all payments of DOD funds under this agreement and all other DOD grants and cooperative agreements to the recipient, and it may suspend or terminate such grants and agreements unilaterally for material failure to comply with the terms and conditions of award."

If your institution has been identified under the procedures established by the Secretary of Defense to implement Section 558, then: (1) no funds available to DOD may be provided to your institution through any grant, including any existing grant, (2) as a matter of policy, this restriction also

applies to any cooperative agreement, and (3) your institution is not eligible to receive a grant or cooperative agreement in response to this solicitation.

MILITARY RECRUITING: For Contracts Only. This is to notify potential Offerors that each contract awarded under this announcement to an institution of higher education shall include the following clause: Defense Federal Acquisition Regulation Supplement (DFARS) clause 252.209-7005, Military Recruiting on Campus. This is to notify potential Offerors that each contract awarded under this announcement to an institution of higher education shall include the following clause: Defense Federal Acquisition Regulation Supplement (DFARS) clause 252.209-7005, Military Recruiting on Campus.

SUBCONTRACTING: For Contracts Only. This section is applicable to contracts where the dollar threshold is expected to exceed to $700,000.00. Pursuant to Section 8(d) of the Small Business Act [15 U.S.C. 637(d)], it is the policy of the Government to enable small business concerns to be considered fairly as subcontractors under all research agreements awarded to prime contractors. The required elements of the Subcontracting Plan are set forth by FAR 52.219-9 (DEVIATION 2013-O0014) and DFARS 252.219-7003.

Subcontracting Plan Goals. Small business subcontracting goals are established on an individual contract basis. The applicant is requested to consider, when appropriate, the Governments' subcontracting goals. When applied to R&D the small business-subcontractor plan should result in the best mix of cost schedule and performance.

EXPORT CONTROL LAWS:

Applicants should be aware of current export control laws and are responsible for ensuring compliance with all International Traffic in Arms Regulation (ITAR) (22 CFR 120 et. Seq.) requirements, as applicable. In some cases, developmental items funded by the Department of Defense are now included on the United States Munition List (USML) and are therefore subject to ITAR jurisdiction. Applicants should address in their proposals whether ITAR restrictions apply or do not apply, such as in the case when research products would have both civil and military application, to the work they are proposing to perform for the Department of Defense. The USML is available online at https://www.ecfr.gov/cgi-bin/text-idx?node=pt22.1.121 Additional information regarding the President's Export Control Reform Initiative can be found at http://export.gov/ecr/index.asp.

DRUG-FREE WORKPLACE:

Assistance Instruments: The recipient must comply with drug-free workplace requirements in Subpart B of 2 CFR part 26, which is the DoD implementation of 41 U.S.C. chapter 81, "Drug-Free Workplace."

Contracts: The appropriate clause(s) shall be added to the award.

DEBARMENT AND SUSPENSION:

Assistance Instruments: The recipient must comply with requirements regarding debarment and suspension in Subpart C of 2 CFR part 180, as adopted by DoD at CFR part 1125. This includes requirements concerning the recipient's principals under an award, as well as requirements

concerning the recipient's procurement transactions and subawards that are implemented in DoD Research and Development General Terms and Conditions PROC Articles I through III and SUB Article II.

Contracts: The appropriate clause(s) shall be added to the award.

REPORTING SUBAWARDS AND EXECUTIVE COMPENSATION:

Assistance Instruments: The recipient must report information about subawards and executive compensation as specified in the award term in Appendix A to 2 CFR part 170, "Reporting subaward and executive compensation information," modified as follows:

1. To accommodate any future designation of a different Government wide Web site for reporting subaward information, the Web site "http://www.fsrs.gov" cited in paragraphs a.2.i. and a.3 of the award provision is replaced by the phrase "http://www.fsrs.gov or successor OMB designated Web site for reporting subaward information";
2. To accommodate any future designation of a different Government wide Web site for reporting executive compensation information, the Web site "http://www.sam.gov" cited in paragraph b.2.i. of the award provision is replaced by the phrase "https://www.sam.gov or successor OMB-designated Web site for reporting information on total compensation"; and 106
3. The reference to "Sec. ___.210 of the attachment to OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations" in paragraph e.3.ii of the award term is replaced by "2 CFR 200.330, as implemented in DoD Research and Development General Terms and Conditions SUB Article I of this award."

Contracts: The appropriate clause(s) shall be added to the award.

F.3 Reporting

Additional reports including number and types will be specified in the award document, but will include as a minimum monthly technical and financial status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed upon before award. Reports and briefing material will also be required as appropriate to document progress in accomplishing program metrics. A final report that summarizes the project and tasks will be required at the conclusion of the performance period for the award.

ARMY MANPOWER CONTRACTOR REPORTING: The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains a secure Army data collection site where the contractor will report ALL contractor manpower (including subcontractor manpower) required for performance of this contract. The contractor is required to completely fill in all the information in the format using the following web address: https://sam.gov/content/home. The required information includes:

1. Contracting Office, Contracting Officer, Contracting Officer's Technical Representative;
2. Contract number, including task and delivery order number;
3. Beginning and ending dates covered by reporting period;
4. Contractor name, address, phone number, e-mail address, identity of contractor employee

entering data;

5. Estimated direct labor hours (including sub-contractors);
6. Estimated direct labor dollars paid this reporting period (including sub- contractors);
7. Total payments (including sub-contractors);
8. Predominate Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different);
9. Estimated data collection cost;
10. Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (the Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information);
11. Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on website);
12. Presence of deployment or contingency contract language; and
13. Number of contractor and sub-contractor employees deployed in theater this reporting period (by country).

As part of its submission, the contractor will also provide the estimated total cost (if any) incurred to comply with this reporting requirement. Reporting period will be the period of performance not to exceed 12 months ending 30 September of each government fiscal year and must be reported by 31 October of each calendar year.

Contractors may use a direct XML data transfer to the database server or fill in the fields on the website. The XML direct transfer is a format for transferring files from a contractor's systems to the secure web site without the need for separate data entries for each required data element at the web site. The specific formats for the XML direct transfer may be downloaded from the web site.

If the total Federal share exceeds $500,000 on any Federal award under a notice of funding opportunity, the post-award reporting requirements reflected in Appendix XII to Part 200 of Title 2 CFR will be included in the award document. This requirement also applies to modifications of awards that: 1) increase the scope of the award, 2) are issued on or after January 1, 2016, and 3) increase the federal share of the award's total value to an amount that exceeds $500,000.

G. Agency Contacts

Questions of a technical nature or a programmatic nature shall be directed as specified below:

ARO Contracting Officer's Representative:

Dr. J. Michael Coyle
Program Manager, Comp. Sci. Branch
Army Research Office
joseph.m.coyle14.civ@mail.mil
919-549-4256

IARPA Program Manager:

Dr. William J. Harrod
AGILE Program Manager
IARPA/Collections Office
william.harrod@iarpa.gov
301-243-1814

Questions of a business nature shall be directed to the cognizant Contracting Officer, as specified below:

ARO Contracting Officer:
Mr. Kevin Bassler
Contracting Officer/ Grants Officer
Army Contracting Command (ACC) - Aberdeen Proving Ground (APG) Research Triangle Park Division (RTP)
PO Box 12211 Research Triangle Park, NC 27709-2211
kevin.j.bassler.civ@army.mil

Comments or questions submitted should be concise and to the point, eliminating any unnecessary verbiage. In addition, the relevant part and paragraph of the Broad Agency Announcement (BAA) should be referenced.

H. Other Information

H.1 Outline of requirements for a cost proposal

COOPERATIVE AGREEMENT Proposals:

The categories below are specific to the Cost Proposal preparation for a cooperative agreement. Before award it must be established that an approved accounting system and financial management system exist.

A.) Direct Labor: Show the current and projected salary amounts in terms of man-hours, man-months, or annual salary to be charged by the principal investigator(s), faculty, research associates, postdoctoral associates, graduate and undergraduate students, secretarial, clerical, and other technical personnel either by personnel or position. State the number of man-hours used to calculate a man-month or man-year. For proposals from universities, research during the academic term is deemed part of regular academic duties, not an extra function for which additional compensation or compensation at a higher rate is warranted. Consequently, academic term salaries shall not be augmented either in rate or in total amount for research performed during the academic term. Rates of compensation for research conducted during non-academic (summer) terms shall not exceed the rate for the academic terms. When part or all of a person's services are to be charged as project costs, it is expected that the person will be relieved of an equal part or all of his or her regular teaching or other obligations. For each person or position, provide the following information:

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

2) 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.

3) The portion of time to be devoted to the proposed research, divided between academic and non-academic (summer) terms, when applicable.

4) The total annual salary charged to the research project.

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

B.) Fringe Benefits and Indirect Costs (Overhead, General and Administrative, and Other): The most recent rates, dates of negotiation, the base(s) and periods to which the rates apply must be disclosed and a statement included identifying whether the proposed rates are provisional or fixed. If the rates have been negotiated by a Government agency, state when and by which agency. A copy of the negotiation memorandum should be provided. If negotiated forecast rates do not exist, Offerors must provide sufficient detail to enable a determination to be made that the costs included in the forecast rate are allocable according to applicable OMB Circulars or FAR/DFARS provisions. Offerors' disclosure should be sufficient to permit a full understanding of the content of the rate(s) and how it was established. As a minimum, the submission should identify:

1) All individual cost elements included in the forecast rate(s);

2) Bases used to prorate indirect expenses to cost pools, if any;

3) How the rate(s) was calculated;

4) Distribution basis of the developed rate(s);

5) Bases on which the overhead rate is calculated, such as "salaries and wages" or "total costs," and

6) The period of the Offeror's fiscal year.

C.) Permanent Equipment: If facilities or equipment are required, a justification why this property should be furnished by the Government must be submitted. State the organization's inability or unwillingness to furnish the facilities or equipment. Offerors must provide an itemized list of permanent equipment showing the cost for each item. Permanent equipment is any article or tangible nonexpendable property having a useful life of more than one year and an acquisition cost of $10,000 or more per unit. The basis for the cost of each item of permanent equipment included in the budget must be disclosed, such as:

1) Vendor Quote: Show name of vendor, number of quotes received and justification, if intended award is to other than lowest bidder.

2) Historical Cost: Identify vendor, date of purchase, and whether or not cost represents lowest bid. Include reason(s) for not soliciting current quotes.

3) Engineering Estimate: Include rationale for quote and reason for not soliciting current quotes. If applicable, the following additional information shall be disclosed in the Offeror's cost proposal:

4) Special test equipment to be fabricated by the awardee for specific research purposes and its cost.

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

6) Existing equipment to be modified to meet specific research requirements, including modification costs. Do not include equipment the organization will purchase with its funds

if the equipment will be capitalized for Federal income tax purposes. Proposed permanent equipment purchases during the final year of an award shall be limited and fully justified.

7) Cooperative agreements may convey title to an institution for equipment purchased with project funds. At the discretion of the contracting/grants officer, the agreement may provide for retention of the title by the Government or may impose conditions governing the equipment conveyed to the organization per the governing laws and regulations.

D.) Travel: Forecasts of travel expenditures (domestic and foreign) that identify the destination and the various cost elements (airfare, mileage, per diem rates, etc.) must be submitted. The costs should be in sufficient detail to determine the reasonableness of such costs. Allowance for air travel normally will not exceed the cost of round-trip, economy air accommodations. Specify the type of travel and its relationship to the research project. Requests for domestic travel must not exceed $10,000 per year per principal investigator. Separate, prior approval by the ARO is required for all foreign travel (i.e., travel outside the continental U.S., its possessions and Canada). Foreign travel requests must not exceed $1,800 each per year per principal investigator. Special justification will be required for travel requests in excess of the amounts stated above and for travel by individuals other than the principal investigator(s). Individuals other than the principal investigator(s) are considered postdoctoral associates, research associates, graduate and undergraduate students, secretarial, clerical, and other technical personnel. Additional travel may be requested for travel to Army laboratories and facilities to enhance agreement objectives and to achieve technology transfer.

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

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

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

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

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

1) A clear description of the work to be performed.

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

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

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

5) A detailed cost summary.

J.) Other Direct Costs: Itemize and provide the basis for proposed costs for other anticipated direct costs such as communications, transportation, insurance, and rental of equipment other than computer related items. Unusual or expensive items shall be fully explained and justified.

K.) Profit/Fee: Profit/fee is not allowed for the Recipient of or subaward to an assistance instrument, where the principal purpose of the activity to be carried out is to stimulate or support a public purpose (i.e., to provide assistance), rather than acquisition (i.e., to acquire goods and services for the direct benefit of the United States 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.

M.) Subcontracting Plan: Subcontracting plans do not apply to assistance instruments.

N.) CONTRACT FACILITIES CAPITAL COST OF MONEY: If cost of money is proposed, a completed Contract Facilities Capital Cost of Money (FCCM) (DD Form 1861) is required.

FOR CONTRACTS: Below are the outlines of the informational requirements for a sample cost proposal.

<u>Cost Proposal – (No Page Limit)</u>. The cover sheet shall include:

1. BAA number;
2. Technical area;
3. Lead Organization submitting proposal;
4. Type of business, selected among the following categories: “LARGE BUSINESS”, “SMALL DISADVANTAGED BUSINESS”, “OTHER SMALL BUSINESS”, “HBCU”, “MI”, “OTHER EDUCATIONAL”, OR “OTHER NONPROFIT”;
5. Contractor’s reference number (if any);
6. Other team members (if applicable) and type of business for each;
7. Proposal title;
8. Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available);

9. Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code, telephone, fax (if available), and electronic mail (if available);
10. Award instrument requested: cost-plus-fixed-free (CPFF), cost-contract—no fee, cost sharing contract – no fee, or other type of procurement contract (specify).
11. Place(s) and period(s) of performance;
12. Total proposed cost separated by basic award and option(s) (if any);
13. Name, address, and telephone number of the proposer's cognizant Defense Contract Management Agency (DCMA) administration office (if known);
14. Name, address, and telephone number of the proposer's cognizant Defense Contract Audit Agency (DCAA) audit office (if known);
15. Date proposal was prepared;
16. DUNS number;
17. TIN number; and
18. Cage Code;
19. Subcontractor Information; and
20. Proposal validity period
21. Any Forward Pricing Rate Agreement, other such approved rate information, or such other documentation that may assist in expediting negotiations (if available).

Reasoning for Submitting a Strong Cost Proposal

The ultimate responsibility of the Contracting Officer is to ensure that all prices offered in a proposal are fair and reasonable before contract award [FAR 15.4]. To establish the reasonableness of the offered prices, the Contracting Officer may ask the Offeror to provide various supporting documentation that assists in this determination. The Offeror's ability to be responsive to the Contracting Officer's requests can expedite contract award. As specified in Section 808 of Public Law 105-261, an Offeror who does not comply with a requirement to submit information for a contract or subcontract in accordance with paragraph (a)(1) of FAR 15.403-3 may be ineligible for award.

DCAA-Accepted Accounting System

Before a contract can be awarded, the Contracting Officer must confirm that the Offeror has a DCAA-accepted accounting system in place for accumulating and billing costs under Government contracts [FAR 53.209-1(f)]. If the Offeror has DCAA correspondence, which documents the acceptance of their accounting system, this should be provided to the Contracting Officer (i.e. attached or referenced in the proposal). Otherwise, the Contracting Officer will submit an inquiry directly to the appropriate DCAA office and request a review of the Offeror's accounting system.

If an Offeror does not have a DCAA-accepted accounting system in place, the DCAA review process can take several months depending upon the availability of the DCAA auditors and the Offeror's internal processes. This will cause a delay in contract award.

For more information about cost proposals and accounting standards, view the link title "Information for Contractors" on the main menu on their website.

Field Pricing Assistance

During the pre-award cost audit process, the Contracting Officer will solicit support from DCAA to determine commerciality and price reasonableness of the proposal [FAR 15.404-2]. Any

proprietary information or reports obtained from DCAA field audits will be appropriately identified and protected within the Government.

H.2 Sample Elements of a Cost Proposal

To help guide Offerors through the pre-award cost audit process, a sample cost proposal is detailed below. This sample also allows the Offeror to see exactly what the Government is looking for; therefore, all cost and pricing back-up data can be provided to the Government in the first cost proposal submission. Review each cost element within the proposal, and take note of the types of documentation that the Contracting Officer will require from the Offeror.

H.2.1 Direct Labor

The first cost element included in the cost proposal is Direct Labor. The DoD requires each proposed employee to be listed by name and labor category. Table H.2.1-1 shows an example of the Direct Labor as proposed by our sample Offeror:

Table H.2.1-1 Direct Labor Table (example)

DIRECT LABOR		YEAR 1			YEAR 2		
Employee Name	**Labor Category**	**Direct Hourly Rate**	**Hours**	**Total Direct Labor**	**Direct Hourly Rate**	**Hours**	**Total Direct Labor**
Andy Smith	Program Manager	$55.00	720.00	$39,600.00	$56.65	720.00	$40,788.00
Bryan Andrew	Senior Engineer	$40.00	672.00	$26,880.00	$41.20	672.00	$27,686.40
Cindy Thomas	Principal Engineer	$50.00	512.00	$25,600.00	$51.50	512.00	$26,368.00
David Porter	Entry Level Engineer	$10.00	400.00	$4,000.00	$10.30	400.00	$4,120.00
Edward Bean	Project Administrator	$25.00	48.00	$1,200.00	$25.75	48.00	$1,236.00
Subtotal Direct Labor (DL)				$97,280.00			$100,198.40

For this cost element, the Contracting Officer requires the Offeror to provide adequate documentation in order to determine that each labor rate for each employee/labor category is fair and reasonable. The documentation will need to explain how these labor rates were derived. For example, if the rates are DCAA- approved labor rates, provide the Contracting Officer with copies of the DCAA documents stating the approval. This is the most acceptable means of documentation to determine the rates fair and reasonable. Other types of supporting documentation may include General Service Administration (GSA) contract price lists, actual payroll journals, or Salary.com research. If an employee listed in a cost proposal is not a current employee (maybe a new employee, or one contingent upon the award of this contract), a copy of the offer letter stating the

hourly rate - signed and accepted by the employee - may be provided as adequate documentation. Sometimes the hourly rates listed in a proposal are derived through subjective processes, i.e., blending of multiple employees in one labor category, or averaged over the course of the year to include scheduled payroll increases, etc. These situations should be clearly documented for the Contracting Officer.

Another cost element in Direct Labor is labor escalation, or the increase in labor rates from Year 1 to Year 2. In the example above, the proposed labor escalation is 3% (ex., Andy Smith increased from $55.00/hr in Year 1, by 3% to $56.65/hr in Year 2). Often times, an Offeror may not propose escalation on labor rates during a 24-month period. Whatever the proposed escalation rate is, please be prepared to explain why it is fair and reasonable [ex., A sufficient explanation for our sample escalation rate would be the Government's General Schedule Increase and Locality Pay for the same time period (name FY) in the same location (name location) was published as 3.5%, therefore a 3% increase is fair and reasonable]

H.2.2 Other Direct Costs (ODCs)

This section of the cost proposal includes all other directly related costs required in support of the effort i.e., materials, subcontractors, consultants, travel, etc. Any cost element that includes various items will need to be detailed in a cost breakdown to the Contracting Officer.

1. Direct Material Costs: This subsection of the cost proposal will include any special tooling, test equipment, and material costs necessary to perform the project. Items included in this section will be carefully reviewed relative to need and appropriateness for the work proposed, and must, in the opinion of the Contracting Officer, be advantageous to the Government and directly related to the specific topic.

   The Contracting Officer will require adequate documentation from the Offeror to determine the cost reasonableness for each material cost proposed. The following methods are ways in which the Contracting Officer can determine this [FAR 15.403-1].

   a. Adequate Price Competition. A price is based on adequate price competition when the Offeror solicits and receives quotes from two or more responsible vendors for the same or similar items or services. Based on these quotes, the Offeror selects the vendor who represents the best value to the Government. The Offeror will be required to provide copies of all vendor quotes received to the Contracting Officer. Note: Price competition is not required for items at or below the micropurchase threshold ($10,000) [FAR 15.403-1]. If an item's unit cost is less than or equal to $10,000, price competition is not necessary. However, if an item's total cost over the period of performance (unit cost * quantity is higher than $10,000, two or more quotes must be obtained by the Offeror.
   b. Commercial Prices. Commercial prices are those published on current price lists, catalogs, or market prices. This includes vendors who have prices published on a GSA-schedule contract. The Offeror will be required to provide copies of such price lists to the Contracting Officer.
   c. Prices set by law or regulation. If a price is mandated by the Government (i.e. pronouncements in the form of periodic rulings, reviews, or similar actions of a governmental body, or embodied in the laws) that is sufficient to set a price.

Table H.2.2-1 provides an example of Direct Material costs included in our sample proposal:

Table H.2.2-1 Direct Material (example)

DIRECT MATERIAL COSTS:	YEAR 1	YEAR 2
Raw Materials	$35,000.00	$12,000.00
Computer for experiments	$4,215.00	$0.00
Cable (item #12-3657, 300 ft)	$1,275.00	$0.00
Software	$1,825.00	$1,825.00
Subtotal Direct Materials Costs (DM):	$42,315.00	$13,825.00

Raw Materials: This is a generic label used to group many material items into one cost item within the proposal. The Contracts Officer will require a detailed breakout of all the items that make up this cost. For each separate item over $10,000 (total for Year 1 + Year 2), the Offeror must be able to provide either competitive quotes received, or show that published pricing was used.

Computer for experiments: Again, this item is most likely a grouping of several components that make up one system. The Contracts Officer will require a detailed breakout of all the items that make up this cost. For each separate item over $10,000 (total for Year 1 + Year 2), the Offeror must be able to provide either competitive quotes received, or show that published pricing was used.

Cable: Since this item is under the simplified acquisition threshold of $10,000, competitive quotes or published pricing are not required. Simply provide documentation to show the Contracting Officer where this price came from.

Software: This cost item could include either one software product, or multiple products. If this includes a price for multiple items, please provide the detailed cost breakdown. Note: The price for Year 1 ($1,825) is below the simplified acquisition threshold; however, in total (Year 1 + Year 2) the price is over $10,000, so competitive quotes or published pricing documentation must be provided

Due to the specialized types of products and services necessary to perform these projects, it may not always be possible to obtain competitive quotes from more than one reliable source. Each cost element over the simplified acquisition threshold ($10,000) must be substantiated. There is always an explanation for HOW the cost of an item was derived; show us how you came up with that price!

When it is not possible for an Offeror to obtain a vendor price through competitive quotes or published price lists, a Contracting Officer may accept other methods to determine cost reasonableness. Below are some examples of other documentation, which the Contracting Officer may accept to substantiate costs:

a. Evidence that a vendor/supplier charged another Offeror a similar price for similar services. Has the vendor charged someone else for the same product? (Two (2) to three (3) invoices from that vendor to different customers may be used as evidence.)
b. Previous contract prices. Has the Offeror charged the Government a similar price under another Government contract for similar services? If the Government has already paid a certain price for services, then that price may already be considered fair and reasonable. (Provide the contract number, and billing rates for reference.)

c. DCAA approved. Has DCAA already accepted or verified specific cost items included in your proposal? (Provide a copy of DCAA correspondence that addressed these costs.)

Table H.2.2-2 shows the remaining ODC portion of our proposal including equipment, subcontractors, consultants, and travel. Assume in this scenario that competitive quotes or catalog prices were not available for these items:

Table H.2.2-2 ODCs including equipment

OTHER DIRECT COSTS:	YEAR 1	YEAR 2
Equipment Rental for Analysis	$5,500.00	$5,600.00
Subcontractor – Widget, Inc.	$25,000.00	$0.00
Consultant: John Bowers	$0.00	$12,000.00
Travel	$1,250.00	$1,250.00
Subtotal ODCs:	$31,750.00	$18,850.00

Equipment Rental for Analysis: The Offeror explains that the Year 1 cost of $5,500 is based upon 250 hours of equipment rental at an hourly rate of $22.00/hr. One (1) invoice from the vendor charging another vendor the same price for the same service is provided to the Contracting Officer as evidence. Since this cost is over the simplified acquisition threshold, further documentation to determine cost reasonableness is required. The Offeror is able to furnish another invoice charging a second vendor the same price for the same service.

Subcontractor – Widget, Inc.: The Offeror provides a copy of the subcontractor quote to the Contracting Officer in support of the $25,000 cost. This subcontractor quote must include sufficient detailed information (equivalent to the data included in the prime's proposal to the Government), so that the Contracting Officer can make a determination of cost reasonableness.

a. As stated in Section 3.5(c)(6) of the DoD Cost Proposal guidance, "All subcontractor costs and consultant costs must be detailed at the same level as prime contractor costs in regards to labor, travel, equipment, etc. Provide detailed substantiation of subcontractor costs in your cost proposal."
b. In accordance with FAR 15.404-3, "the Contracting Officer is responsible for the determination of price reasonableness for the prime contract, including subcontracting costs". This means that the subcontractor's quote/proposal may be subject to the same scrutiny by the Contracting Officer as the cost proposal submitted by the prime. The Contracting Officer will need to determine whether the subcontractor has an accepted purchasing system in place and/or conduct appropriate cost or price analyses to establish the reasonableness of proposed subcontract prices. Due to the proprietary nature of cost data, the Subcontractor may choose to submit their pricing information directly to the Contracting Officer and not through the prime. This is understood and encouraged.
c. When a subcontractor is selected to provide support under the prime contract due to their specialized experience, the Contracting Officer may request sole source justification from the Offeror.

Consultant – John Bowers: Again, the Offeror shall provide a copy of the consultant's quote to the Contracting Officer as evidence. In this example, the consultant will be charging an

hourly rate of $125 an hour for 96 hours of support. The Offeror indicates to the Contracting Officer that this particular consultant was used on a previous contract with the Government (provide contract number), and will be charging the same rate. A copy of the consultant's invoice to the Offeror under the prior contract is available as supporting evidence. Since the Government has paid this price for the same services in the past, determination has already been made that the price is fair.

Travel: The Contracting Officer will require a detailed cost breakdown for travel expenses to determine whether the total cost is reasonable based on Government per diem and mileage rates. This breakdown shall include the number of trips, the destinations, and the number of travelers. It will also need to include the estimated airfare per round trip, estimated car rental, lodging rate per trip, tax on lodging, and per diem rate per trip. The lodging and per diem rates must coincide with the Joint Travel Regulations. Please see the following website to determine the appropriate lodging and per diem rates: http://www.defensetravel.dod.mil/site/perdiemCalc.cfm. Additionally, the Offeror must provide why the airfare is fair and reasonable as well. Sufficient back up for both airfare and car rental would include print outs of online research at the various travel search engines (Expedia, Travelocity, etc.) documenting the prices for airfare and car rentals thus proving why your chosen rate is fair and reasonable.

Table H.2.2-3 shows a sample of the travel portion.

Table H.2.2-3 Travel portion of ODCs

TRAVEL		Trips	Travelers	Nights	Days	Unit Cost	Total Travel
Airfare	per roundtrip	1	1			$996.00	$996.00
Lodging	per day	1	1	1		$75.00	$75.00
Tax on Lodging (12%)	per day	1	1	1		$9.00	$9.00
Per Diem	per day	1	1		2	$44.00	$88.00
Automobile Rental	per day	1	1		2	$41.00	$82.00
Subtotal Travel							$1,250.00

H.2.3 Indirect Rates

Indirect rates include elements such as Fringe Benefits, General & Administrative (G&A), Overhead, and Material Handling costs. The Offeror shall indicate in the cost proposal both the indirect rates (as a percentage) as well as how those rates are allocated to the costs in the proposal. Table H.2.3-1 shows the indirect portion of our sample proposal.

Table H.2.3-1 Indirect rates

INDIRECTS	YEAR 1	YEAR 2
Subtotal Direct Labor (DL):	$97,280.00	$100,198.40
Fringe Benefits, if not included in Overhead, rate (15.0000 %) X DL =	$14,592.00	$15,029.76
Labor Overhead (rate 45.0000 %) X (DL + Fringe) =	$50,342.40	$51,852.67
Total Direct Labor (TDL):	$162,214.40	$167,080.83

In this example, the Offeror includes a Fringe Benefit rate of 15.00% that it allocated to the Direct Labor costs. They also propose a Labor Overhead rate of 45.00% that is allocated to the Direct Labor costs plus the Fringe Benefits.

All indirect rates and the allocation methods of those rates must be verified by the Contracting Officer. In most cases, DCAA documentation supporting the indirect rates and allocation methods can be obtained through a DCAA field audit or proposal review. Many Offerors have already completed such reviews and have this documentation readily available. If an Offeror is unable to participate in a DCAA review to substantiate indirect rates, the Contracting Officer may request other accounting data from the Offeror to make a determination.

H.2.4 Cost of Money (COM)

If Cost of Money (an imputed cost that is not a form of interest on borrowings (see FAR 31.205-20); an "incurred cost" for cost-reimbursement purposes under applicable cost-reimbursement contracts and for progress payment purposes under fixed-price contracts; and refers to— (1) Facilities capital cost of money (48 CFR 9904.414); and (2) Cost of money as an element of the cost of capital assets under construction (48 CFR 9904.417)) is proposed in accordance with FAR 31.205-10, a DD Form 1861 is required to be completed and submitted with the contractor's proposal.

H.2.5 Fee/Profit

The proposed fee percentage will be analyzed in accordance with DFARS 215.404, the Weighted Guidelines Method.

H.2.6 Subcontracting Plan

If the total amount of the proposal exceeds $700,000 and the Offeror is a large business or an institute of higher education (other than HBCU/MI) and the resultant award is a contract, the Offeror shall be prepared to submit a subcontracting plan for small business and small disadvantaged business concerns. A mutually agreeable plan will be included in and made a part of the contract.

APPENDICES

Appendix A: AGILE Workflows and Benchmark Descriptions

Appendix A.1 Knowledge Graphs - Groups, Relationships and Interests

Knowledge graphs store entities, their semantic types, properties, meta-data, provenance information, and the relationships among them as first-class objects. Data is organized and meaning is encoded via ontologies. Multiple ontologies can be applied, each customized for a specific domain or user community, reducing confusion and improving collaboration and knowledge discovery.

Knowledge graphs of interest may be dynamically time varying. Applications of interest include discovery of new entities and relationships, traceable evidence pathways, complex events over space and time, anomalous patterns of activities, precursor events, and complex system models. Building and maintaining knowledge graphs requires processing a multitude of data types, including streaming and static data that can be unstructured or structured. Data types can include video, images, voice, signals, text, documents, maps, sensor data, graphs, matrices, tensors, plus others. This data needs to be curated and prepared through steps of error correction, entity disambiguation, and entity association.

The analytics composing the AGILE workflows encompass a broad range of techniques. Analysts need efficient interactive query processing to support explorative analyses and their iterative refinement. This highly interactive and evolving workflow is required to efficiently explore the relationships among the entities of the knowledge graph, to infer the missing elements in the knowledge base, to cluster together similar entities, and to generate the rationale/body of evidence for the discovered entities and relationships. All of these essential tasks require a combination of semi-supervised and unsupervised methods to learn meaningful representations of the data (e.g., projecting entities in high dimensional geometric spaces).

Selected Knowledge Graph workflow components with target metrics: On current computing systems, workflows for transforming data to knowledge takes days. AGILE's goal is to reduce these workflows (data ingestion, data curation, and knowledge discovery) to minutes. More specifically, the knowledge graph workflow will require AGILE systems to achieve the following capabilities:

- Data ingestion rates of 10B records/second or better (100x today's 100M records/second).
- Perform embedding learning in 30 minutes or less (50x today's 1,440 seconds).
- Perform vertex classification with graph neural networks in 30 minutes or less (50x today's >1,440 seconds).
- Perform link prediction with graph neural networks in 30 minutes or less (50x today's >1,440 seconds).
- Achieve 3-5 hops in 1 minute for multi-hop reasoning using fuzzy matching and reasoning (vs. today's capability of 1-2 links exact match/logic in 30 minutes).

For the purpose of the statements above, today's computers are assumed to be departmental level multi-cabinet systems. Problem sizes can be inferred from the performance estimates for today's computers.

Appendix A.2 Detection – System and Event Patterns

This workflow will have many of the same knowledge requirements as knowledge graph workflows, but now entities have state and may transition spontaneously to new states whenever their properties, relationships, and/or neighborhood structure changes. Event detection systems try to answer such questions as:

- What is an event?
- What are the material requirements of an event?
- Which requirements are present, which can be inferred, and which can be anticipated?
- What are precursor events?
- How do events progress in time?
- Who/what are key drivers/influencers of events?

Whenever a state change occurs, the change must be communicated to neighbors asynchronously without global control. Vertices and edges of these graphs must have types, properties, methods, and as patterns of interest emerge in the graph send alerts to analysts tagged with appropriate confidence levels.

Key modules may include:

- Deep neural nets to identify words/phrases, images, signals/packets.
- Signal/entity/event disambiguation to match instance data to knowledge graph patterns.
- Belief propagation algorithms to modify or extend patterns.
- Asynchronous state management and propagation of data/conditions without global control.
- Context/consequence inference (walking the graph to determine the effect of state change on other nodes).
- Response optimization (comparing which change will restore/mitigate/counter the previous state change).
- Data filtering and compression to eliminate clutter.

Selected System and Event Pattern Detection workflow components with target metrics: Today, we cannot identify emerging patterns incrementally or discover multi-day and/or multi-location patterns. In many problems of interest, it may take days to return a good guess of what does emerge. AGILE's goal is to issue prioritized alerts and course of actions in a matter of hours. The System and Event Pattern Detection workflow will require AGILE systems to achieve the following capabilities:

- Process 10PB graphs or more (1000x today's 10TB capability).
- Ingest streaming data at least 10B records per second from at least 3 different sources (vs. today limited to single stream ingest at 100M records/second).
- Support at least 10B graph edits (inserts/deletes/updates) per second (1000x today's batch edits – limited to 10M edits/second).
- Fuzzy match multiple event patterns per minute, with analyst-defined branches and conditions (vs. today's exact match of a single, linear event per minute).
- Support incremental pattern detection. Store partial patterns extending them as new data arrives and alert when "interest" thresholds are exceeded. (Not done today.)
- Process multi-day, multi-location queries in minutes. (Not done today.)

Appendix A.3 Sequence Data – Identification and Clustering

This workflow addresses the challenge of annotating large-scale sequence data (temporal sequences of data) to identify common structures, inheritance, and functionality. Data could include: temporal sequences of text messages, documents, video streams, signal data, event sequences, and other sources. One approach for predicting function is by clustering sequences through unsupervised learning techniques. By building similarity graphs of sequences and performing graph clustering, one can identify modular structures in large-scale data that can be used for functional annotation through semi-supervised learning algorithms (transductive learning).

Clustering data sequences through unsupervised learning can expand existing knowledge about functionality, including: (1) characterization of agents, their operational signatures, and potential threats; (2) early identification of agents, with improved sensitivity and specificity; and (3) function and capacity of agents in complex communities.

Typically, a workflow in this domain will include at least the following four modules:

- Ingesting and preparing sequence data from multiple open-source databases.
- Constructing similarity graphs using metrics such as Jaccard index.
- Graph clustering of the similarity network.
- Analyzing clusters for functional annotations – i.e., using transductive learning approaches to predict labels (functions) for new sequences, based on a limited set of labeled data and structural information (graph clustering).

The first module scales linearly with data size (the number of sequences) and is compute bound. The second module scales quadratically with data size and requires a balanced machine (compute, memory, network communication). The third module, graph clustering, is a prototypical graph analytics kernel with numerous applications. Current graph sizes are on the order of 25B edges; future problems will need to cluster graphs with trillions of edges, i.e., 100x current graph sizes. Since clustering is virtually 100% remote communications, future systems will need 100x greater bi-section network bandwidth.

A fifth workflow module, which, although important, is not currently performed, is:

- Estimating uncertainties of labels and functions to prioritize alerts.

This workflow component will be included in the end-to-end workflow for this area.

Selected Sequence Data workflow components with target metrics: In many of today's problems, workflows for transforming sequence data to agent characterizations, recognized activities, and potential threats take more than a month. Estimating uncertainties and prioritizing alerts isn't even done. AGILE's goal is to increase the number of data sequences analyzed per unit time by three orders of magnitude and to issue prioritized alerts from these analyzed sequences. Proposed AGILE system designs should also provide the means for dealing with future graph sizes of trillions of edges. The Sequence Data workflow will require AGILE systems to achieve the following capabilities:

- Ingest and prepare sequence data from multiple data lakes in 4 hours or less (25x improvement over today's 100 hours).
- Construct similarity graphs, using metrics such as Jaccard index, in 6 hours or less (70-100x today's more than 400 hours).

- Cluster the similarity graphs in 10 hours or less (50x today's 500 hours)
- Predict labels (functions) of new sequences in 4 hours or less (25x today's 200 hours).
- Provide estimates of uncertainties of labels and functions to prioritize alerts. (Not done today).

Appendix A.4 Network - Cyber-Physical Systems

Engineered systems such as military bases, comprise complex interconnected networks such as electric power generation and transmission, communication and control, transportation of vehicles and resources such as water and natural gas, and human (social) networks. Defending such systems against random and coordinated attacks is a major challenge, requiring: (1) efficient modeling of network of networks, (2) identification of key influential entities in the interdependent networks, and (3) efficient design and development of defense strategies. The ability to model complex systems with sufficient fidelity to predict how failures caused by intentional threats or natural physical degradation is a key challenge and enabler for both active defense and multi-domain targeting.

Efficient modeling of network of networks requires the interconnection of networks with different properties and structure, the composition of network simulators with different temporal and spatial scales, and the seamless joining of inter-network touch points. Moreover, network entities must be able to invoke methods asynchronously and without global control when events occur that change their state. When state changes occur, invoked methods will propagate information to neighbors or invoke network simulators to recompute global conditions. A variety of methods must be supported by AGILE systems, including machine learning, scientific systems of equations, rule-based agents, linear algebra, and graph analytics.

Identifying key nodes in a complex network is a challenging computation to scale for large networks. *Influence maximization* techniques use local entity relationships to identify the top-k influential nodes for a network by simulating the dynamics using Monte Carlo methods. Today, we can solve the influence maximization problem on graphs with a few million vertices and a few hundred million edges with reasonable accuracy and small seed sets. Since computation time grows non-linearly [at least quadratically] relative to number of vertices, seed set size, and accuracy, future problems will require 1000x improvement in memory size and compute power.

Building on detailed models and simulations and having identified key influential nodes in a network of networks, one can compute solutions for optimal (or approximately best) defense of the network using game theory and network interdiction. Game theoretic methods often involve nonlinear optimization and thus provide challenges for current large-scale computer systems. Two player games can be simulated with a dozen processors. Larger multi-player games that consider complex mixed-strategy solutions with thousands of possible system states will require computer systems capable of solving non-linear optimization problems in real time.

Selected Network-Cyber workflow components with target metrics: The goal of this application area is to achieve incremental cyber analysis and defense of network of networks systems with at least 10B vertices and 100B edges, returning prioritized course of actions in less than an hour. Currently, no such capability exists. The Network-Cyber workflow will require AGILE systems to achieve the following capabilities for networks with at least 10B vertices and 100B edges:

- Achieve graph construction using game theoretic modeling in 2 minutes or less (60x today's capability of 120 minutes).
- Identify top k-influential nodes in 1 minute or less (60x today's 60 min).

- Run enhanced models for identifying top *k* nodes in 30 minutes or less (20x today's 600 min).
- Execute belief propagation in 2 minutes or less (60x today's 120 min).
- Perform incremental analysis, never having to recompute from scratch. (Not done today).

Appendix B: FAR 52.209-11

FAR 52.209-11: Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016)

(a) As required by sections 744 and 745 of Division E of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L 113-235), and similar provisions, if contained in subsequent appropriations acts, the Government will not enter into a contract with any corporation that--

(1) Has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless an agency has considered suspension or debarment of the corporation and made a determination that suspension or debarment is not necessary to protect the interests of the Government; or

(2) Was convicted of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless an agency has considered suspension or debarment of the corporation and made a determination that this action is not necessary to protect the interests of the Government.

(b) The Offeror represents that—

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

(2) It is [ ] is not [ ] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

Appendix C: Definitions

Clean Sheet – is a design methodology that starts without a preconceived design or other concepts. The effort is driven by the required capabilities and other characteristics that will influence the design such that a resulting prototype achieves these capabilities. This approach does not drive the effort to utilize existing design components.

Workflow – is a composition of numerous applications or computational tasks coupled with exchanging information over a memory or storage hierarchy & networks involving data centers, edge computing, or sensor systems.

Kernel – is software, determined by one or more of the workflows, used to evaluate critical combinations of hardware components and runtime system features.

Micro-kernel – is software, determined by one or more of the workflows, to measure individual hardware components.

AGILE Applications – includes the AGILE Workflows, Kernels, and Benchmarks

Workload – refers to tasks required to handle, and process work as needed for application software during a period of time. It includes load/store operations, computational instructions, synchronization operations, system function calls, and other actions.

Application Framework – consists of a set of libraries and tools that are used to build an application

Runtime System – is an abstraction of computing system software structure and operation for a specific system design. It provides a conceptual framework for the co-design of technology: architecture, programming interfaces, and system software.

Computer Architecture – is a set of rules and methods that describe the functionality, organization, and implementation of a computer systems. It includes descriptions of the capabilities and runtime system model of a computer but not a particular implementation.

AGILE System Design – provides a system-level design of the proposed AGILE architecture. It could be used to develop an implementation of the AGILE architecture. The design must emphasize optimization of the fully integrated system, not just optimization of the individual subsystems (compute, communication, memory, and runtime). It is a system level design that involves multiple nodes in the AGILE architecture. It provides the protocol and policies that are required for an implementation.

Node – is a device at the endpoint in a computer's internal interconnection network.

Co-Design Process – involves bringing application and domain specialists together with computer scientists, hardware architects machine designers, software runtime designers, and compiler experts to ensure that an iterative design-led optimization process can be established seeking to balance the many tradeoffs and benefits of a new computer architecture with novel approaches in system software, programming models, numerical methods and application/algorithm design.

High-level Behavioral Model – models the behavior of a component at the functionality level. This model will not provide accurate circuit timing but provides functionally correct results and approximate timing. The end goal is to ensure expected system behavior, correctness, and

provide initial performance estimates. It is used to evaluate detailed SW, such as the runtime system.

Functional Model – A behavioral model augmented with a more detailed model on the functionality of the circuit. This model may have a more detailed timing model as well.

Register Transfer Level – an abstraction of a digital circuit design, where every state element of the system is explicitly modeled at clock edge. RTL models can also include non-clocked elements such as logic gates that update their outputs with any change in input. The purpose of this model is to validate (1) performance at the clock level (number of clocks to execute), and (2) validate the final high-level behavioral model for correctness. An RTL model can also be translated to a collection of hardware gates and wires. With the proper testbench (such as FPGA emulation) it can also be used to evaluate software, such as the runtime system.

Architectural design (Phase 1) – a system-level model that accurately describes the interactions between hardware components on a node and within the system. The components are described by high-level behavioral models. The Architectural Design will be independently evaluated by the T&E Team using A-SST.

Detailed Design (Phase 2) – a system-level model that accurately describes the interactions between the components on a node and within the system, including an accurate timing model for the node and system as a whole. The components are described by an RTL design (for AGILE-developed integrated circuits) or a functional model (for COTS integrated circuits). The detailed design will be independently evaluated by the T&E Team using A-SST.

Appendix D: Table of Abbreviations

Table D-1 Abbreviations

ACC-APG	Army Contracting Command-Aberdeen Proving Ground
AFARS	Army Federal Acquisition Regulation Supplement
AGILE	Advanced Graphic Intelligence Logical Computing Environment
ARL-ARO	Army Research Laboratory - Army Research Office
ARO	Army Research Office
ASIC	Application Specific Integrated Circuits
A-SST	AGILE-enhanced Structural Simulation Toolkit
BAA	Broad Agency Announcement
BFS	Breadth First Search
CAGE	Commercial and Government Entity
CDR	Critical Design Review
CFDA	Catalog of Federal Domestic Assistance
CFR	Code of Federal Regulations
COM	Cost of Money
COTS	Commercial Off-The-Shelf
CPFF	Cost-plus-fixed-fee
CRADA	Cooperative Research and Development Agreements
DCAA	Defense Contract Audit Agency
DCMA	Defense Contract Management Agency
DFARS	Defense Federal Acquisition Regulation Supplement
DL	Direct Labor
DLSC	Defense Logistics Service Center
DoD	Department of Defense
DoDGAR	DoD Grant and Agreement Regulations
DoDI	Department of Defense Instruction
FAPIIS	Federal Awardee performance and Integrity Information System
FAR	Federal Acquisition Regulation
FDA	Food and Drug Administration
FPGA	Field Programmable Gate Arrays
FSC	Federal Service Code
FY	Fiscal year
G&A	General & Administrative
GFE	Government Funded Equipment
GFI	Government Furnished Information
GSA	General Service Administration
HBCU	Historically Black Colleges and Universities
HRPO	Human Research Protection Office
HSR	Human Subjects Research
I/O	Input/Output
IARPA	Intelligence advanced Research Projects Activity

IC	Intelligence Community
IP	Intellectual Property
ITAR	International Traffic in Arms Regulation
MI	Minority Institution
MSR	Monthly Status Report
ODC	Other Direct Cost
PB	Petabyte
PDF	Portable Document Format
PDR	Preliminary Design Review
PI	Principal Investigator
PM	Program Manager
POSIX	Portable Operating System Interface
PWS	Performance Work Statement
RTL	Register Transfer Level
RTP	Research Triangle Park
SAM	System for Award Management
SOW	Statement of Work
SST	Structural Simulation Toolkit
T&E	Testing and Evaluation
TB	Terabyte
TEPS	Traversed Edges per Second
TIN	Taxpayer Identification Number
UCAR	University Affiliated Research Center
UIC	Unit Identification Code
USDA/APHIS	United States Department of Agriculture Office of Animal and Plant Health Inspection Service
USML	United States Munition List