IARPA

BROAD AGENCY ANNOUNCEMENT

IARPA-BAA-14-06

Machine Intelligence from Cortical Networks (MICrONS)

Office of Safe and Secure Operations
IARPA-BAA-14-06

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Machine Intelligence from Cortical Networks (MICrONS)

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Part One: Overview Information

This publication constitutes a Broad Agency Announcement (BAA) and sets forth a research area of interest in neurally-inspired machine learning. Awards based on responses to this BAA are considered to be the result of full and open competition.

- **Federal agency name:** Intelligence Advanced Research Projects Activity (IARPA)
- **Funding opportunity title**: Machine Intelligence from Cortical Networks (MICrONS) Program
- **Announcement type**: Initial
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  - BAA closing date: January 7, 2016
- **Anticipated individual awards:** Multiple awards are anticipated
- **Types of instruments that may be awarded**: Procurement contracts are anticipated
- **Agency contact information**:
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- **Program Manager:** R. Jacob Vogelstein, Office of Safe and Secure Operations
- **Program website:** http://www.iarpa.gov/index.php/research-programs/microns

BAA Summary: The goal of the MICrONS program is to revolutionize machine learning by reverse-engineering the algorithms of the brain. IARPA seeks multidisciplinary approaches that combine neuroscience and data science to understand the cortical computations underlying neural information processing and to deploy mathematical abstractions of these operations in novel machine learning algorithms.

Questions: Questions about administrative, technical or contractual issues must be submitted to the BAA e-mail address at dni-iarpa-baa-14-06@iarpa.gov. If e-mail is not available, fax questions to 301-851-7678, Attention: IARPA-BAA-14-06. All requests must include the name, e-mail address (if available) and phone number of a point of contact for the requested information. Do not send questions with proprietary content. A consolidated Question and Answer response will be publicly posted on the Federal Business Opportunities website (http://www.fbo.gov) and linked from the IARPA website (http://www.iarpa.gov/index.php/research-programs/microns); no answers will go directly to the submitter.

Part Two: Full Text of Announcement

SECTION 1: FUNDING OPPORTUNITY DESCRIPTION

The Intelligence Advanced Research Projects Activity (IARPA) often selects its research efforts through the Broad Agency Announcement (BAA) process. The following information is for those wishing to respond to this Program BAA.

IARPA is seeking innovative solutions for the Machine Intelligence from Cortical Networks (MICrONS) program. MICrONS seeks to revolutionize machine learning by reverse-engineering the algorithms of the brain. The program is expressly designed as a dialogue between data science and neuroscience. Participants in the program will have the unique opportunity to pose biological questions with the greatest potential to advance theories of neural computation and obtain answers through carefully planned experimentation and data analysis. Over the course of the program, participants will use their improving understanding of the representations, transformations, and learning rules employed by the brain to create ever more capable neurally-derived machine learning algorithms. Ultimate computational goals for MICrONS include the ability to perform complex information processing tasks such as one-shot learning, unsupervised clustering, and scene parsing, aiming towards human-like proficiency.

The use of a BAA solicitation allows the Government to select from a wide range of novel ideas and concepts to support program objectives. The MICrONS program is envisioned to begin in September 2015 and end by September 2020.

1.A Program Overview

1.A.1 Introduction

Despite significant progress in machine learning over the past few years, today's state of the art algorithms are brittle and do not generalize well. In contrast, the brain is able to robustly separate and categorize signals in the presence of significant noise and non-linear transformations, and can extrapolate from single examples to entire classes of stimuli. This performance gap between software and wetware persists despite some correspondence between the architecture of the leading machine learning algorithms and their biological counterparts in the brain, presumably because the two still differ significantly in the details of operation. The MICrONS program is predicated on the notion that it will be possible to achieve major breakthroughs in machine learning if we can construct synthetic systems that not only resemble the high-level blueprints of the brain, but also employ lower-level computing modules derived from the specific computations performed by cortical circuits.

1.A.2 Background

Many contemporary theories of cortical computing suggest that the brain performs common sensory information processing tasks—such as detection and recognition of visual objects, sounds, and odors—with algorithms that progressively transform data through a series of operations, or "stages." Each stage of processing is further theorized to occur within a discrete region of cortex. Although different theories suggest different mathematical bases for

computation, it is commonly believed that neural algorithms employ data representations, transformations, and learning rules that are conserved across stages.[1] It should therefore be possible to apprehend the neural computations underlying information processing (at least within a given sensory modality[2]) by interrogating a small fraction of the entire cortex, so long as that fraction is judiciously selected to contain sufficient evidence of the representations, transformations, and learning rules of the algorithm(s) to which it contributes.

Neuroscience has a long history of inspiring innovation in machine learning, starting with the seminal work of McCulloch and Pitts in 1943. This influence is evident even in today's state of the art "deep learning" systems, which are loosely modeled on hierarchical visual processing systems in the primate brain. However, the rate of effective knowledge transfer between neuroscience and machine learning has been slow because of divergent scientific priorities, funding sources, knowledge repositories, and lexicons. As a result, very few of the ideas about neural computing that have emerged over the past few decades have been incorporated into modern machine learning algorithms.

Previous attempts to foster collaboration between neuroscience and machine learning have been stymied in part by gaps in our knowledge about the brain. The majority of what is known about the brain today regards its operation at the "micro" scale (one or a few neurons) and the "macro" scale (hundreds of thousands or millions of neurons), and some of this information is indeed reflected in the design of leading artificial neural networks. In contrast, much less is known about the "mesoscale" cortical circuits (hundreds to tens of thousands of neurons) that implement the specific data representations, transformations, and learning rules of cortical information processing algorithms, and these are therefore absent from (or speculative in) existing machine learning solutions. It is likely that explicit knowledge and use of these computations is required to move beyond the current generation of "neurally-inspired" machine learning algorithms.

1.A.3 Program Synopsis

The MICrONS program aims to create novel machine learning algorithms that use neurally-inspired architectures *and* mathematical abstractions of the representations, transformations, and learning rules employed by the brain to achieve brain-like performance. To guide the construction of these algorithms, performers will conduct targeted neuroscience experiments that interrogate the operation of mesoscale cortical computing circuits, taking advantage of emerging tools for high-resolution structural and functional brain mapping. The program is designed to facilitate iterative refinement of algorithms based on a combination of practical, theoretical, and experimental outcomes: performers will use their experiences with the algorithms' design and performance to reveal gaps in their understanding of cortical computation, and will collect specific neuroscience data to inform new algorithmic implementations that address these limitations. Ultimately, as performers incorporate these insights into successive versions of the machine learning algorithms, they will devise solutions that can perform complex information processing tasks aiming towards human-like proficiency.

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[1] Some theories assert that individual stages of an algorithm can be further decomposed into a limited set of recurring structural and/or functional motifs (e.g., cortical columns). The description of neural algorithms as multi-stage processes in the text above is inclusive of theories that define repeating computational units within each stage.
[2] Although some theories assert that the brain uses the same algorithm to process all types of data, the MICrONS program is agnostic in this regard.

1.A.4 Program Structure

MICrONS is organized in three phases (one 18 month base period, a first option period of 24 months, and a second option period of 18 months), totaling five years in duration. During each phase, performers conduct targeted neuroanatomical and neurophysiological studies to inform their understanding of the cortical computations underlying sensory information processing and, concurrently, create neurally-derived machine learning algorithms that perform similar functions. Performers motivate their experimental and algorithmic designs by formulating and updating a conceptual model or "theoretical framework" for neural information processing in a given sensory modality. They use computational neural models (i.e., executable mathematic or algorithmic simulations of neurons and neural circuits) to establish a correspondence between the computations performed by biological wetware and the computations employed by their machine learning software. Each phase ends with an information processing challenge that assesses how well the new algorithms perform on increasingly challenging machine learning tasks: similarity discrimination in Phase 1, generalization and classification in Phase 2, and invariant recognition in Phase 3. Performers use the results of their experiments in each phase to guide their development of improved algorithms in the subsequent phase (in Phase 1, performers base their algorithms on the existing neuroscience literature). A brief summary of the computational, experimental, and modeling objectives of each phase is presented in Table 1.

1.A.5 Technical Areas

The MICrONS program comprises three Technical Areas (TAs). Although IARPA anticipates receiving a number of holistic proposals responding to all three TAs, it recognizes that some prospective offerors may have capabilities in only a subset of the overall program scope, and wishes to maximize its opportunity to leverage these capabilities. Therefore, offerors may choose to propose to one, two, or all three TAs. Because achieving MICrONS program goals will require significant collaboration across all three TAs, offerors who propose to only one or two TAs should be prepared to work closely with performers in the remaining TAs. The TAs in MICrONS are defined as follows:

- TA1 – experimental design, theoretical neuroscience, computational neural modeling, machine learning, neurophysiological data collection, and data analysis;
- TA2 – neuroanatomical data collection; and
- TA3 – reconstruction of cortical circuits from neuroanatomical data and development of information technology systems to store, align, and access neural circuit reconstructions with the associated neurophysiological and neuroanatomical data.

Success in the MICrONS program will require extensive communication and cooperation between performers in all three TAs within or across teams. For example, in TA2, performers must collect neuroanatomical data about the same brain regions *in the same brain specimens* that are used in TA1 for neurophysiological studies; in TA3, performers must reconstruct neural circuits from the data collected in TA2; and in TA1, performers must analyze the neural circuits generated in TA3 and use the resulting insights in formulating their machine learning algorithms and theoretical frameworks. All offerors are therefore required to include in their proposal a detailed management plan (Section 4.B.1.c(viii)) and a detailed description of how their proposed technical approach in one or more TAs is likely to impact the other TAs (Section 1.C.4).

Table 1: Summary of the scientific and technical objectives of each program phase

Phase	Theory and Modeling Objectives	Computational Objectives	Experimental Objectives
1 Month 1-18	Evaluate candidate representations, transformations, and learning rules underlying neural information processing. Create computational neural models illustrating plausible neural mechanisms (based on the existing neuroscience literature) for the proposed functions. Translate insights from the operation of the models into computational processes that support machine learning. Use requirements and limitations of the machine learning algorithms to motivate investigation of alternative neural mechanisms and update models and experiment design accordingly.	Develop a neurally-derived algorithm that uses mathematical abstractions of the representations, transformations, and learning rules employed by the brain. Validate the design by demonstrating the ability to judge two stimuli drawn from the same class to be more similar than two stimuli drawn from different classes (aka "similarity discrimination").	Illuminate the representations, transformations, and learning rules underlying computations in a targeted brain region by collecting neurophysiological data at single-neuron and sub-second resolution in a 500 x 500 x 100 um^3 cortical volume and by reconstructing the neural circuits within a co-registered 100 x 100 x 100 um^3 subvolume at single-synapse resolution to inform the models and algorithms in Phase 2. Supplement descriptions of these "mesoscale" circuits with additional details at larger and/or smaller scales.
2 Month 19-42	Use the data acquired in Phase 1 to inform, modify, and constrain the representations, transformations, and learning rules. Translate insights from the operation of updated computational models into computational processes that support machine learning. Use requirements and limitations of the updated machine learning algorithms to motivate alternative interpretations of the neural data and update models and experiment design accordingly.	Update the algorithm based on insights and constraints from new data and computational models. Demonstrate the ability to generalize from a single exemplar of a given class of stimuli to multiple other class members (aka "one-shot learning"). Define class boundaries that delineate stimuli drawn from different classes, in the absence of any class exemplars (aka "unsupervised clustering").	Comprehensively characterize the representations, transformations, and learning rules underlying computations in a targeted brain region by collecting neurophysiological data at single-neuron and sub-second resolution in a 1 x 1 x 0.5 mm^3 cortical volume and reconstructing the neural circuits within a co-registered 1 x 1 x 1 mm^3 volume at single-synapse resolution to inform the models and algorithms in Phase 3. Supplement descriptions of these "mesoscale" circuits with additional details at larger and/or smaller scales.

Phase	Theory and Modeling Objectives	Computational Objectives	Experimental Objectives
3 Month 43-60	Use the data acquired in Phase 2 to further elucidate and enhance the biological fidelity of the representations, transformations, and learning rules. Translate insights from the operation of updated models into computational processes that support machine learning. Use requirements and limitations of the updated machine learning algorithms to motivate alternative interpretations of the neural data and update models accordingly.	Further augment the algorithm based on insights and constraints from new data and computational models. Demonstrate the ability to recognize instances of one or more classes of stimuli within a complex composition (aka "scene") given single exemplars from each class. Demonstrate potential for the algorithm to generalize to abstract, non-sensory data.	Address latent defects or deficits in Phase 1 and Phase 2 structural and functional data to inform the models and algorithms in Phase 3.

1.B Program Metrics, Milestones, Waypoints, and Deliverables

IARPA will use program metrics to evaluate the effectiveness of proposed solutions in achieving the stated program objectives. These metrics will be applied to work products ("deliverables") to be provided by the performers at specific points in time ("waypoints" and "milestones") during program execution. Performers are said to "meet" or "pass" the waypoint or milestone when their deliverables reach or exceed a criterion value ("target") for each metric. The metrics, waypoints, and milestones are intended to bound the scope of effort while affording maximum flexibility, creativity, and innovation in proposing solutions to the stated problem. Note that these targets represent the minimum requirements—IARPA anticipates that offerors will need to exceed some of these targets to achieve their specific scientific objectives.

Waypoints and milestones are defined to help IARPA determine whether sufficient progress is being made to warrant continued funding of the program. They are not intended to restrict which aspects of the research may be performed during each phase of the program. Each offeror should propose a research plan with timing that is designed to meet the program waypoints and milestones while simultaneously supporting the offeror's overall technical approach.

1.B.1 Metrics and Deliverables for Technical Area 1

1.B.1.a Machine Learning Algorithm

In TA1, performers will develop novel, neurally-derived machine learning algorithms. These algorithms will be assessed at the end of each phase on two criteria: (1) their performance on a "demonstration task" that exercises the algorithm's underlying representations, transformations, and learning rules; and (2) their "neural fidelity," defined as the correspondence between the algorithm's representations, transformations, and learning rules and their biological counterparts in the brain.

The demonstration tasks are designed to progressively evaluate more sophisticated functionality of the algorithms, starting with an illustration of each algorithm's ability to detect similarities between objects of the same class in Phase 1; moving to a more complex exposition of the algorithm's capacity to generalize from single examples and identify class boundaries in Phase 2; and concluding with a challenging assay in invariant recognition in Phase 3. Performers will also define a demonstration task of their choosing in Phase 3 that establishes the applicability of their algorithm to more abstract tasks involving non-sensory data.

In addition to demonstrating the algorithm's capabilities, in each phase each performer will deliver a summary report on the machine learning algorithm. The report shall be written and presented in the style of a journal article intended for an audience of data scientists, and must include sufficient information to allow IARPA to understand the algorithm and efficiently evaluate its neural fidelity. Neural fidelity will be assessed by a panel of experts who will confirm that the algorithm employs representations, transformations, and learning rules that are substantiated by the computational models and the experimental (neurophysiological and neuroanatomical) data produced in all three TAs of this program or described in the existing neuroscience literature. Consequently, the report shall, at minimum, include:

- A high-level overview of the algorithm;
- An annotated illustration of the algorithm's major components;
- A description of the algorithm's supporting methods or modules such as preprocessing stages, output layers, linking operations, parameter tuning functions, etc.;
- A description of how the algorithm was "trained," if necessary;
- A mathematical formulation of the following aspects of the algorithm's design, with explicit references to the neurophysiological and neuroanatomical (TA2/TA3) data and computational neural models that inform and substantiate:
    - The way in which the algorithm represents data,
    - The key data transformations or operations performed by the algorithm,
    - The supervised and unsupervised learning rules employed by the algorithm, and
    - The role of top-down and lateral feedback in the algorithm;
- A description of the challenges posed by the demonstration task, along with:
    - A description of existing solutions to these challenges and their limitations, and
    - A description of how the newly developed algorithm addresses these challenges;
- A description of how the performer's experience with the algorithm will affect their design and interpretation of neuroscience experiments, neural circuit analyses, and computational neural models in the next phase of the program; and
- A description of how the results from neuroscience experiments, neural circuit analyses, and computational neural models in the next phase of the program will inform the performer's design and implementation of the next version of the algorithm.

Demonstration tasks

The Phase 1 demonstration task (Task 1 in Table 2) is designed to assess the viability of the representations, transformations, and learning rules employed by the algorithm without requiring substantial investment in supporting software infrastructure. In this task, the algorithm will be presented with individual test patterns representing isolated "items" in the performer's chosen sensory domain (e.g., objects in the visual domain, sounds in the auditory domain, simulated mixtures of volatiles in the olfactory domain, etc.).[3] Each input test pattern should produce a corresponding output pattern in a format to be determined by the performer. The collection of test patterns will contain unlabeled items drawn from a number of different synthetic "classes,"[4] with two members of each class represented in the collection. A successful demonstration will show that the output representations of two items drawn from the same class are separated by a smaller distance than the output representations of two items drawn from different classes, using a performer-defined distance measure, at a rate significantly higher than chance. Performers will not be given test patterns in advance, but IARPA will provide representative examples at

[3] IARPA will define the format of the test patterns in collaboration with the performers early in each phase.

[4] As defined here, a "class" is a collection of items that can be defined by an unspecified property or set of properties that all of its members share. For example, in the visual domain, "dogs" represent a natural class, as do "basset hounds;" in the auditory domain, "voices" represent a natural class; etc. The classes from which test patterns are drawn will be synthetic classes, i.e. classes lacking an obvious natural counterpart (see, for example, Figure 1a in Tenenbaum et al., DOI: 10.1126/science.1192788).

program kickoff. IARPA will not provide any training data; offerors must indicate in their proposals how they intend to train the algorithms, if necessary.[5]

There are two closely-related demonstration tasks in Phase 2 (Tasks 2a and 2b in Table 2), both of which are designed to build upon the capabilities developed in Phase 1. The first task assesses the capacity of the algorithm to generalize from single examples (aka "1-shot learning"). The second task surveys the algorithm's ability to identify class boundaries within a set of test patterns even if no labeled examples are provided (aka "unsupervised clustering"). In both Phase 2 demonstration tasks, the algorithm will be presented with a set of test patterns, where each test pattern represents an isolated item in the appropriate sensory domain. The set will contain one or more unlabeled items from a number of different synthetic classes. In Task 2a, the algorithm will be provided with a set of labeled "example patterns" that contains a single exemplar from each class. Given these examples, the algorithm will be required to identify the class membership of all the unlabeled items in the test set. A successful demonstration will reproduce the "true" class assignments with 70% proficiency, relative to human performance. In Task 2b, the algorithm will not be provided with any example patterns, and will therefore have to determine how many classes are contained in the set of test patterns, as well as identify the items within each inferred class. A successful demonstration will reproduce the "true" number of classes and the "true" class assignments with 60% proficiency, relative to human performance. As with the Phase 1 demonstration, performers will not be given test patterns or example patterns in advance, but IARPA will provide representative examples at the Phase 2 kickoff meeting. IARPA will not provide any training data; offerors must indicate in their proposals how they intend to train the algorithms, if necessary.

The Phase 3 demonstration task (Task 3 in Table 2) is intended to evaluate the robustness of the mechanisms demonstrated in Phase 2 to various linear and non-linear transformations within a more realistic operational scenario (akin to scene parsing). In this task, the algorithm will be presented with test patterns representing complex "scenes" in the appropriate sensory domain. Each scene will be composed of zero or more "target patterns" embedded within a number of "distractor patterns." The distractor patterns may be wholly separate from the target patterns, may partially occlude the target patterns, or may otherwise comingle with the target patterns. Target patterns and distractor patterns will be drawn from different classes of stimuli. In addition to the test pattern, the algorithm will be provided with a set of "example patterns" that contain a single exemplar from each class of potential target pattern. For each class, the algorithm will be required to detect all of the target patterns of that class within the scene, or declare the absence of any target patterns of that class. A successful demonstration will correctly identify the presence or absence of at least 80% of the test patterns that humans judge accurately.[6] As with the demonstrations in other phases, performers will not be provided with the set of test patterns or example patterns in advance, but IARPA will provide representative examples (along with the associated target and distractor patterns) at the Phase 3 kickoff meeting. IARPA will not provide any training data; offerors must indicate in their proposals how they intend to train the algorithms, if necessary.

[5] Training data need not be of the same type as the testing data; for example an algorithm in the visual domain could be trained on dynamic videos and tested on static images.

[6] Accuracy will be computed using a weighted combination of standard signal detection theory measures such as True Positive Rate, False Positive Rate, True Negative Rate, and False Negative Rate.

A core premise of this program is that the computations and algorithms that enable proficient execution of the sensory information processing tasks described above will effectively generalize to abstract, non-sensory data. Correspondingly, by the end of Phase 3, performers must demonstrate this capability. In their proposals, offerors must describe the demonstration task (Task 4 in Table 2) they intend to perform to illustrate the generalization ability of their algorithm, the data they will employ, and the metrics and performance targets they propose to enable IARPA to evaluate the effectiveness of the implemented solution. The design of this task and assessment strategy will be an important consideration in proposal review. Performers should expect to update their task design as the program progresses and provide more detailed specifications in the machine learning report to be delivered at designated program milestones (Table 7).

A summary of all four demonstration tasks and their corresponding performance targets is presented in Table 2.

Table 2: Demonstration tasks and performance targets for machine learning algorithms

Demonstration Task	Phase / Milestone	Performance Target
Similarity discrimination (Task 1)	Phase 1 / Milestone 1.2	Statistically significant ($p > 0.05$)
1-shot learning (Task 2a)	Phase 2 / Milestone 2.2	70% (relative to human baseline)
Unsupervised clustering (Task 2b)	Phase 2 / Milestone 2.2	60% (relative to human baseline)
Scene parsing (Task 3)	Phase 3 / Milestone 3.3	80% (relative to human baseline)
Abstract, non-sensory data (Task 4)	Phase 3 / Milestone 3.3	Offeror-defined

At the end of each phase, performers will deliver executable versions of their machine learning algorithms along with documented source code and instructions for using the executable to perform the demonstration tasks. If the algorithm requires "training" before use, the performer shall deliver two versions of the software, one that is pre-trained and one that can be trained from a set of data that is packaged (or accessible remotely) with the executable. Any specialized computing hardware or software required to execute the code or train the algorithm must be described in a "System Specification Document" (SSD). Performers will deliver drafts of the SSD to IARPA at specified program waypoints (Table 7).

1.B.1.b Computational Neural Models

In each phase, performers in TA1 will develop executable neural models and simulations that incorporate salient aspects of the experimentally observed structure and function of cortical circuits (based on the work of all three TAs in the previous phase, or from the existing neuroscience literature in Phase 1). These models will yield insight into the representations, transformations, and learning rules employed by the brain and inform the design of the machine learning algorithm. Concurrently, the implementation and operation of the algorithm will suggest new hypotheses about the computations of the brain and motivate alternative interpretations of the data via new models.

At the end of each phase, each performer will deliver a report on their computational neural models. The report shall be written and presented in the style of a journal article intended for an audience of computational neuroscientists and must include sufficient information to allow IARPA to assess the models on the following four criteria: (1) structural fidelity, (2) functional

fidelity, (3) model credibility, and (4) model fitness.[7] "Structural fidelity" will judge the extent to which models reproduce prominent anatomical features of cortical networks. These features may include the connectivity between different cells or different cell types, the number of cells or classes of cells represented in the model, the morphology of individual cells or cell types, etc. "Functional fidelity" will judge the extent to which the models reproduce prominent dynamics of cortical networks (such as attractor states, chaotic trajectories, temporal coherence, etc.). Both structural and functional fidelity will be judged relative to the existing neuroscience literature and the data acquired in this program. "Model credibility" will judge the model's economy of explanation, robustness to noise and parameter variation, reliance upon uncommon or unlikely neural mechanisms and parameter values, and other related factors. "Model fitness" will judge the overall efficacy of the model in connecting neuroscience and machine learning. All of these evaluations will be qualitative (pass/fail), but will be based on quantitative data provided in the report. Therefore, the report shall, at minimum, summarize:

- The theory and/or data (from neuroscience and machine learning) that motivated each model;
- The aspects of each model that reflect the structure of cortical circuits (e.g., circuit architecture, number of neurons or neural populations, cell types, etc.), with reference to specific data products from the neural circuit reconstructions in TA3 (Section 1.B.3.b);
- Key details regarding the implementation and analysis of each model;
- Representative data from simulations and analyses of each model that:
    - Establishes a correspondence between the model's behavior and the dynamics of the associated cortical circuits, with reference to specific epochs in the acquired functional data,
    - Suggests specific representations, transformations, and learning rules employed by the associated cortical circuits, with reference to the corresponding components of the machine learning algorithm, and
    - Illustrates the model's robustness (or lack thereof) to reasonable amounts of input stimulus variability, additive noise, and/or parameter variation;
- The impact and implications of each model on the performer's:
    - Theoretical framework for cortical computing in the selected sensory modality,
    - Machine learning algorithm design,
    - Interpretation of data acquired in the current, previous, or next phase of the program, and
    - Experimental design for the next phase of the program.
- How the neuroscience experiments, neural circuit reconstructions, and machine learning algorithms developed in the next phase of the program will inform the design of the next version of each model.

Table 3 summarizes the computational neural modeling metrics, target values, and reference data at the time of evaluation.

[7] Specific evaluation standards appropriate for each performer's unique technical approach will be developed by IARPA in collaboration with the performer.

Table 3: Metrics and target values for computational neural models

Metric	Phase / Milestone	Target	Reference Data
Structural fidelity Functional fidelity Model credibility Model fitness	Phase 1 / Milestone 1.2	Pass	Existing published literature
Structural fidelity Functional fidelity Model credibility Model fitness	Phase 2 / Milestone 2.2	Pass	Existing published literature and Phase 1 neural data in all TAs
Structural fidelity Functional fidelity Model credibility Model fitness	Phase 3 / Milestone 3.3	Pass	Existing published literature and Phase 2 neural data in all TAs

In addition to the report, performers must deliver documented source code for all models and analyses along with instructions for running simulations and reproducing the data and figures in the report. Any specialized computing hardware or software required to exercise this code must be described in an SSD. Performers will deliver drafts of the SSD to IARPA at specified program waypoints (Table 7).

1.B.1.c Neurophysiological Data Collection

In TA1, each performer must acquire functional data on mesoscale cortical circuits to inform the development of neurally-derived machine learning algorithms. This functional data will ultimately be co-registered with structural data from the same tissue (Sections 1.B.2.a and 1.B.3.a). The neurophysiological data must specify the time series activation per neuron in response to some set of external stimuli and conditions and meet the criteria defined in Table 4. To complement the metrics in Table 4, offerors should specify additional metrics and associated performance targets at program waypoints and milestones that are tailored to their specific technical approach to neurophysiological data acquisition. For example, if the offeror intends to employ imaging technologies for data acquisition, appropriate metrics may include the signal-to-noise ratio at various cortical depths.

Table 4: Metrics and target values for neurophysiological data acquisition

Metric	Phase 1 Target (Milestone 1.2)	Phase 2 Target (Milestone 2.2)
Spatial extent	≥ 500 μm x 500 μm x 100 μm	≥ 1000 μm x 1000 μm x 500 μm, wholly contained within the extent of the neuroanatomical data
Spatial resolution	Offeror-defined, but must be sufficient to resolve activity from individual neurons	Offeror-defined, but must be sufficient to resolve activity from individual neurons
Temporal resolution	≥ 5 Hz	≥ 5 Hz
Recording density[8]	50%	75%

[8] As defined here, "recording density" is the percentage of neurons in the functional data volume from which neural activity is recorded at single neuron resolution.

Due to the potentially very large file size of acquired neurophysiological data, IARPA will not require performers to deliver physical media containing this data. Instead, performers may provide a link to an online resource housing this data, and instructions for how to access the data. In addition, all performers must provide a written description of how the data is stored, organized, and formatted in an SSD; and deliver drafts of the SSD to IARPA at specified program waypoints (Table 7). Performers will be encouraged to collaborate with other teams in formulating their SSDs.

1.B.2 Metrics and Deliverables for Technical Area 2

1.B.2.a Neuroanatomical Data Collection

In TA2, each performer must acquire structural data on the mesoscale cortical circuits studied in TA1 to inform TA1 performers' development of neurally-derived machine learning algorithms. This neuroanatomical data must meet the criteria specified in Table 5. Note that this data must be acquired in the same brain regions *in the same brain specimens* used in TA1, such that the combined data product across both TAs is a comprehensive description of the structure and function of a specified region of cortex. To complement the metrics in Table 5, offerors should specify additional metrics and associated performance targets at program waypoints and milestones that are tailored to their specific technical approach to neuroanatomical data acquisition. For example, if the offeror intends to employ imaging technologies for data acquisition, appropriate metrics may include the minimum image contrast, percentage of corrupted pixels/voxels, uniformity of voxel size, and other image-quality measures.

Table 5: Metrics and target values for neuroanatomical data acquisition

Metric	Phase 1 Target (Milestone 1.2)	Phase 2 Target (Milestone 2.2)
Spatial extent	≥ 100 μm x 100 μm x 100 μm, wholly contained within the extent of the neurophysiological data	≥ 1000 μm x 1000 μm x 1000 μm, or L μm x W μm x D μm where LWD ≥ 1 mm^3 and D is the cortical thickness
Spatial resolution	Offeror-defined, but must be sufficient to reconstruct the complete connectivity (at single-synapse resolution) and morphology of all neurons	Offeror-defined, but must be sufficient to reconstruct the complete connectivity (at single-synapse resolution) and morphology of all neurons
Acquisition rate (in units of cortical volume per time)	Offeror-defined	Offeror-defined

Due to the potentially very large file size of acquired neuroanatomical data, IARPA will not require performers to deliver physical media containing this data. Instead, performers may provide a link to an online resource housing this data, and instructions for how to access the data. In addition, all performers must provide a written description of how the data is stored, organized, and formatted in an SSD and deliver drafts of the SSD to IARPA at specified program waypoints (Table 7). Performers will be encouraged to collaborate with other teams in formulating their SSDs.

1.B.3 Metrics and Deliverables for Technical Area 3

1.B.3.a Co-registration of Structural and Functional Data

To help performers in TA1 elucidate the role(s) that neurons play in their myriad interconnected networks, performers in TA3 must align the functional and structural data collected in TA1 and TA2, respectively. Performers shall represent the result of this alignment as a (sparse) four-dimensional dataset, wherein the activity of each neuron may be indexed by its relative location and its relative time. At minimum, the co-registration must be sufficient to align structural and functional data at the scale of cell bodies. Performers may choose to co-register the data at higher resolutions if their functional recordings resolve activity localized to neural processes outside the soma (e.g., dendritic spines). Co-registered data must be made accessible to IARPA through a software interface described in Section 1.B.3.c.

1.B.3.b Neural Circuit Reconstruction

Performers in TA3 must generate a quantitative description of the connectivity (at the resolution of individual synapses) and morphology of all neurons in the co-registered structural and functional data to facilitate understanding of the underlying neural circuits. Conceptually, this undertaking is equivalent to reverse-engineering an integrated circuit to reveal the overall schematic and the transistor specifications.

The reconstructed neural circuits generated by performers will be evaluated against "ground truth" semi-automated or manual reconstructions that IARPA will generate from the same structural data. Performers' reconstructions must be made accessible to IARPA through a software interface described in Section 1.B.3.c. Metrics are defined for four aspects of neural circuit reconstruction: synapse detection, connection specificity, morphological accuracy, and speed/throughput (Table 6).

Synapse detection is measured by precision and recall, as defined in the formulas below. Because the number of synapses in the overall dataset will greatly exceed the number that can be "ground-truthed," the metrics will be calculated for a randomly selected sample population of synapses.

$$Precision = \frac{\#\ Synapses\ Correctly\ Detected}{Total\ \#\ of\ Synapses\ Detected}$$

$$Recall = \frac{\#\ Synapses\ Correctly\ Detected}{\#\ of\ Synapses\ in\ Ground\ Truth}$$

IARPA will use the Normalized Information Distance (NID) metric to assess connection specificity. In this context, the NID describes the information that the connections to and from one neuron (G_i) in the ground truth data provide about the connections to and from neurons (S) in the reconstructed data. Mathematically, NID is defined as:

$$NID(G_i, S) = 1 - \frac{I(G_i, S)}{H(S)}$$

where $I(G_i, S)$ is the "synaptic mutual information" between neuron G_i and the set of neurons S, and $H(S)$ is the "synaptic entropy" of the set of neurons S. Synaptic mutual information $I(G_i, S)$ is a function of the number of matching synapses (based on anatomical location and synapse directionality) between neuron G_i and each neuron S_j in S. The synaptic entropy of S is calculated by summing the entropies of the set of synapses associated with each neuron S_j in S. Because NID is formulated as a normalized distance measure, it ranges from zero (for a perfect reconstruction) to one (for a completely erroneous reconstruction). Target values are specified on the distribution of NID scores across a sample population of reconstructed neurons.

Because morphology can be represented in a number of ways (e.g., skeletons, volumetric representations, etc.), offerors are required to propose their own metrics for measuring the accuracy of morphological reconstruction. Although IARPA will work with performers to refine these metrics and develop a methodology for implementing them, the viability of proposed metrics will be an important consideration in proposal review.

Table 6: Metrics and target values for neural circuit reconstruction

Metric	Phase 1 Target (Milestone 1.2)	Phase 2 Target (Milestone 2.2)
Synapse detection		
Precision	≥ 80%	≥ 95%
Recall	≥ 80%	≥ 95%
Connection specificity (NID)	≤ 0.95 @ 20th percentile ≤ 0.50 @ 50th percentile ≤ 0.20 @ 90th percentile	≤ 0.95 @ 10th percentile ≤ 0.25 @ 50th percentile ≤ 0.05 @ 80th percentile
Morphological accuracy	Offeror-defined	Offeror-defined
Speed (reconstructed cortical volume per unit time)	Offeror-defined	Offeror-defined

To complement the metrics defined by IARPA, offerors should specify additional metrics and associated performance targets at program waypoints and milestones that are tailored to their specific technical approach to neural circuit reconstruction.

1.B.3.c Neural Data Access

In TA3, each performer is required to store and provide remote access to the co-registered structural and functional neural data (Section 1.B.3.a) and neural circuit reconstructions (Section 1.B.3.b) generated in each phase through a well-documented software interface. Each performer in TA3 may define their own interface specification; however, performers will be encouraged to collaborate with other teams in formulating their designs. In addition, to the extent possible, IARPA will attempt to establish common standards across all TA3 performers.

Performers must document their software interface for neural data access in an SSD and deliver drafts of the SSD to IARPA at specified program waypoints (Table 7). The interface specification must, at minimum, define functionality sufficient for IARPA to efficiently access the data, conduct the evaluations, and compute the metrics defined in Sections 1.B.3.a and 1.B.3.b by the end of each phase. In particular, this implies the ability to:

- Visualize and download selected regions of structural data (to create ground-truth neural circuit reconstructions);
- Visually select a specific neuron and/or synapse in the structural data and obtain its identifier;
- Programmatically access specific neurons and/or synapses in the reconstructed neural circuits via their unique identifiers;
- Visualize and download the locations of selected synapses in the reconstructed neural circuits (so they can be compared with the locations of synapses in the ground truth reconstructions);
- Visualize and download the morphologies of selected neurons in the reconstructed neural circuits (so they can be compared with the morphologies of corresponding neurons in the ground truth reconstructions);
- Identify, visualize, and download the locations of all pre- and post-synaptic terminals associated with selected neurons (to calculate the connection specificity metric);
- Overlay and visualize neuroanatomical data with the corresponding neural circuit reconstructions;
- Download selected records and epochs of neural activity with annotations indicating the timing of relevant stimuli, behaviors, external manipulations, and other experiment events;
- Link each record of neural activity to the corresponding neurons (or neural processes) in the structural data and reconstructed neural circuits; and
- Verify accurate co-registration between the functional and structural datasets.

1.B.4 Milestones and Waypoints

Program milestones are generally associated with the major deliverables or the end of a phase. At each milestone, each performer is expected to provide deliverables that meet the performance targets for all of the metrics defined in the previous sections, including any offeror-defined metrics. Waypoints help IARPA assess intermediate progress towards the next milestone(s). Table 7 summarizes the program milestones and waypoints, along with their associated deliverables. For convenience, program events such as Technical Exchange Meetings (TEMs) and site visits are also included in this table.

To accommodate a variety of technical approaches, each offeror may propose appropriate dates for completing neurophysiological data collection (Milestones 1.A and 2.A) and neuroanatomical data collection (Milestones 1.B and 2.B) in each phase.[9] In determining these dates, offerors should consider that, in TA2, performers must collect neuroanatomical data from the same brain specimens used to collect neurophysiological data in TA1 (Section 1.B.1.c); and in TA3, performers must co-register the functional and structural data collected in TA1 and TA2 (Section 1.B.3.a) and reconstruct the neural circuits contained within this data (Section 1.B.3.b). Offerors

[9] Performers who intend to collect functional and/or structural data from more than one specimen may continue to do so after these milestones; the milestones are intended to apply only to the data from whichever brain specimen performers choose to submit to meet the specifications given in Sections 1.B.1, 1.B.2, and 1.B.3.

should therefore anticipate the timing requirements of all three TAs and specify a timeline that is likely to meet those requirements.

For TA1 waypoints that assess "intermediate progress towards Phase [1 | 2 | 3] reports," proposals must describe the expected content of draft reports on the machine learning algorithm (Section 1.B.1.a)[10] and the computational neural models (Section 1.B.1.b),[11] as well as a report documenting advances in the design of any proposed novel analytical techniques (Section 1.C.1.b(iv))[12] and preliminary results from the application of those techniques and other planned analyses to the acquired structural and functional data.[13]

For TA1 waypoints that assess "intermediate progress towards neurophysiological data collection target," proposals must specify a set of performance targets for all of the metrics defined in Section 1.B.1.c (including any offeror-defined metrics), as well as describe the deliverables the offeror intends to provide to substantiate performance at those waypoints.

For TA2 waypoints that assess "intermediate progress towards neuroanatomical data collection target," proposals must specify a set of performance targets for all of the metrics defined in Section 1.B.2.a (including any offeror-defined metrics), as well as describe the deliverables the offeror intends to provide to substantiate performance at those waypoints. If the offeror does not expect data collection on the target specimen to begin until after a particular waypoint, they must instead describe their expected progress towards data collection on sample ("practice") tissue at this waypoint and specify an additional waypoint by which they will have data on the target specimen.

For TA3 waypoints that assess "intermediate progress towards neural circuit reconstruction target," proposals must specify a set of performance targets for all of the metrics defined in Section 1.B.3.b (including any offeror-defined metrics), as well as describe the deliverables the offeror intends to provide to substantiate performance at those waypoints. If the offeror does not expect to be able to compute a particular metric at a particular waypoint, they shall specify an alternate quantitative measure of intermediate progress. If the offeror does not anticipate commencing neural circuit reconstruction on the target specimen at a particular waypoint, they must instead describe their expected progress towards neural circuit reconstruction on sample ("practice") tissue at this waypoint and specify an additional waypoint by which they will have data on the target specimen.

[10] For example, in the draft machine learning report for Phase 1, the offeror might expect to describe preliminary results for a prototype machine learning algorithm.

[11] For example, in the draft computational neural models report for Phase 1, the offeror might expect to describe results from three out of five planned models.

[12] For example, if an offeror intends to develop new mathematical techniques for finding repeated motifs in neural circuits, it may be appropriate to define a metric on the accuracy of these techniques and provide a performance target on simulated data at one or more of the program waypoints.

[13] Final results should support various aspects of the machine learning algorithms and computational neural models, and should be incorporated into the corresponding end-of-phase reports.

Table 7: Program waypoints and milestones

Month	Event	Description	Deliverables
Phase 1 (Months 1 – 18)			
Month 1	Phase 1 Kickoff	• Kickoff meeting	• Kickoff meeting presentations
Month 3	Waypoint 1.1	• Phase 1 IACUC protocol(s) approved	• [TA1 & TA2] Complete IACUC protocols w/ institutional approval
Month 6	Waypoint 1.2	• First draft of Phase 1 System Specification Documents (SSDs) complete	• [TA1] Draft machine learning SSD • [TA1] Draft computational neural models SSD • [TA1] Draft neurophysiological data SSD • [TA2] Draft neuroanatomical data SSD • [TA3] Draft neural data access SSD
	Site visits	• Individual team meetings at performers' worksites	• Site visit presentations
Month 9	Waypoint 1.3	• Intermediate progress towards Phase 1 neurophysiological data collection target • Intermediate progress towards Phase 1 neuroanatomical data collection target • Intermediate progress towards Phase 1 neural circuit reconstruction target	• [TA1] Offeror-defined neurophysiological data deliverables • [TA2] Offeror-defined neuroanatomical data deliverables • [TA3] Offeror-defined neural circuit reconstruction deliverables
Offeror-defined	Milestone 1.A	• Phase 1 neurophysiological data collection complete	• [TA1] Neurophysiological data
Month 11	Waypoint 1.4	• Intermediate progress towards Phase 1 reports	• [TA1] Draft machine learning report • [TA1] Draft computational neural modeling report • [TA1] Draft neural data analysis report

Month	Event	Description	Deliverables
	Milestone 1.1	• Final Phase 1 SSDs	• [TA1] Machine learning SSD v1.0 • [TA1] Computational neural models SSD v1.0 • [TA1] Neurophysiological data SSD v1.0 • [TA2] Neuroanatomical data SSD v1.0 • [TA3] Neural data access SSD v1.0
Month 12	TEM	• Technical exchange meeting	• TEM presentations
Offeror-defined	Milestone 1.B	• Phase 1 neuroanatomical data collection complete	• [TA2] Neuroanatomical data
Month 16	Milestone 1.2	• Phase 1 machine learning algorithms complete • Phase 1 computational neural models complete • Neural data co-registration complete • Neural circuit reconstruction complete • Neural data access software v1 complete	• [TA1] Machine learning algorithms (source code and executables) • [TA1] Phase 1 machine learning report • [TA1] Computational neural models (source code and executables) • [TA1] Phase 1 computational neural modeling report • [TA3] Co-registered structural and functional data • [TA3] Neural circuit reconstructions • [TA3] Version 1 software for neural data access
Month 18	Waypoint 1.5	• Phase 2 IACUC protocol(s) approved (if necessary)	• [TA1 & TA2] Complete IACUC protocols w/ institutional approval

Month	Event	Description	Deliverables
Phase 2 (Months 19 – 42)			
Month 19	Phase 2 Kickoff	• Kickoff meeting	• Kickoff meeting presentations
Month 24	Waypoint 2.1	• First draft of Phase 2 SSDs complete	• [TA1] Draft machine learning SSD • [TA1] Draft computational neural models SSD • [TA1] Draft neurophysiological data SSD • [TA2] Draft neuroanatomical data SSD • [TA3] Draft neural data access SSD
	Site visits	• Individual team meetings at performers' worksites	• Site visit presentations
Month 27	Waypoint 2.2	• Intermediate progress towards Phase 2 neurophysiological data collection target • Intermediate progress towards Phase 2 neuroanatomical data collection target • Intermediate progress towards Phase 2 neural circuit reconstruction target	• [TA1] Offeror-defined neurophysiological data deliverables • [TA2] Offeror-defined neuroanatomical data deliverables • [TA3] Offeror-defined neural circuit reconstruction deliverables
Month 29	Waypoint 2.3	• Intermediate progress towards Phase 2 reports	• [TA1] Draft machine learning report • [TA1] Draft computational neural modeling report • [TA1] Draft neural data analysis report
	Milestone 2.1	• Final Phase 2 SSDs	• [TA1] Machine learning SSD v2.0 • [TA1] Computational neural models SSD v2.0 • [TA1] Neurophysiological data SSD v2.0 • [TA2] Neuroanatomical data SSD 2.0 • [TA3] Neural data access SSD v2.0

Month	Event	Description	Deliverables
Offeror-defined	Milestone 2.A	• Phase 2 neurophysiological data collection complete	• [TA1] Neurophysiological data
Month 30	TEM	• Technical exchange meeting	• TEM presentations
Month 35	Waypoint 2.4	• Intermediate progress towards Phase 2 neuroanatomical data collection target • Intermediate progress towards Phase 2 neural circuit reconstruction target	• [TA2] Offeror-defined neuroanatomical data deliverables • [TA3] Offeror-defined neural circuit reconstruction deliverables
Offeror-defined	Milestone 2.B	• Phase 2 neuroanatomical data collection complete	• [TA2] Neuroanatomical data
Month 36	Site visits	• Individual team meetings at performers' worksites	• Site visit presentations
Month 40	Milestone 2.2	• Phase 2 machine learning algorithms complete • Phase 2 computational neural models complete • Neural data co-registration complete • Neural circuit reconstruction complete • Neural data access software v2 complete	• [TA1] Machine learning algorithms (source code and executables) • [TA1] Phase 2 machine learning report • [TA1] Computational neural models (source code and executables) • [TA1] Phase 2 computational neural modeling report • [TA3] Co-registered structural and functional data • [TA3] Neural circuit reconstructions • [TA3] Version 2 software for neural data access
Month 42	Waypoint 2.5	• Phase 3 IACUC protocol(s) approved (if necessary)	• [TA1 & TA2] Complete IACUC protocols w/ institutional approval

Month	Event	Description	Deliverables
Phase 3 (Months 43 – 60)			
Month 43	Phase 3 Kickoff	• Kickoff meeting	• Kickoff meeting presentations
Month 48	Milestone 3.1	• Phase 3 neurophysiological data collection complete (if necessary) • Phase 3 neuroanatomical data collection complete (if necessary)	• [TA1] Neurophysiological data • [TA2] Neuroanatomical data
	Site visits	• Individual team meetings at performers' worksites	• Site visit presentations
Month 51	Waypoint 3.1	• Intermediate progress towards Phase 3 reports	• [TA1] Draft machine learning report • [TA1] Draft computational neural modeling report • [TA1] Draft neural data analysis report
	Milestone 3.2	• Neural data co-registration complete • Neural circuit reconstruction complete • Final Phase 3 SSDs	• [TA3] Co-registered structural and functional data • [TA3] Neural circuit reconstructions • [TA1] Machine learning SSD v3.0 • [TA1] Computational neural models SSD v3.0 • [TA1] Neurophysiological data SSD v3.0 • [TA2] Neuroanatomical data SSD v3.0 • [TA3] Neural data access SSD v3.0
Month 54	TEM	• Technical exchange meeting	• TEM presentations
Month 58	Milestone 3.3	• Phase 3 machine learning algorithms complete • Phase 3 computational neural models complete • Neural data access software v3 complete	• [TA1] Machine learning algorithms (source code and executables) • [TA1] Phase 3 machine learning report • [TA1] Computational neural models (source code and executables) • [TA3] Version 3 software for neural data access
Month 60	Milestone 3.4	• End of program	• Final summary report (see Section 6.B.8 for details)

1.B.5 Test and Evaluation

IARPA will utilize an independent and impartial Test and Evaluation (T&E) team to assist with evaluating and assessing the deliverables from all performers. In particular, the T&E team will:

- Develop challenge problems and test data (but not training data) to evaluate the machine learning algorithms (Section 1.B.1.a);
- Establish baseline performance for the machine learning demonstration tasks (Table 2);
- Use the delivered machine learning software to perform the machine learning demonstration tasks and conduct the associated assessments (Section 1.B.1.a);
- Convene a panel of experts to review the neural fidelity of the representations, transformations, and learning rules employed by the machine learning algorithms (Section 1.B.1.a);
- Work with the performers to devise a specific methodology for assessing the structural and functional fidelity of their computational neural models (Section 1.B.1.b);
- Convene a panel of experts to review the credibility and fitness of the computational neural models (Section 1.B.1.b); Work across performers to standardize neuroscience data formats and software interfaces, where possible (Sections 1.B.1.c, 1.B.2.a, and 1.B.3.c);
- Create a ground-truth neural circuit reconstruction from each data set (Section 1.B.3.b); and
- Compute performance on all metrics defined in Sections 1.B.1, 1.B.2, and 1.B.3.

1.C Proposal Guidance

A detailed description of the required technical elements of proposals is presented below, organized by program Technical Area. All of these elements must be addressed in the "Research Plan" component of proposal Volume 1 (Section 4.B.1.c(i)). As described in Section 1.A.5, proposals may address one or more TAs; however, achieving MICrONS program goals will require significant collaboration across all three TAs.

To facilitate interoperability and data exchange among teams, offerors who do not propose to all three TAs will be required to use a common commercial cloud service provider for data storage and large-scale data analyses. Offerors proposing to all three TAs may use a commercial provider of their choice or a private/custom information technology solution. All offerors shall specify their preferred implementation platform in their proposal and provide a justification of their choice that addresses technical, logistical, and financial considerations (including costs associated with data transport). IARPA will choose the common commercial cloud service provider based on the offerors' preferences and other factors and notify selected offerors prior to contract negotiation.

1.C.1 Guidance for Technical Area 1

Technical Area 1 involves multidisciplinary research to identify cortical computations and to develop and deploy mathematical abstractions of these operations in novel machine learning algorithms. Proposals should: (1) posit a biologically-plausible theoretical framework of cortical computing that may explain sensory information processing in one or more cortical areas; (2) use that framework to motivate a research plan that will answer specific neuroscientific questions

about the representations, transformations, and learning rules employed in those brain regions; and (3) use those answers to advance machine learning.

1.C.1.a Theoretical Framework

Proposals must describe one or more conceptual models or "theoretical frameworks" of cortical computing[14] that the offeror believes to explain how the brain recognizes and separates patterns in a given sensory domain.[15] As used in this document, a theoretical framework is analogous to a design pattern in software engineering: it is a high-level specification of a class of algorithms that can be implemented in a number of different ways (for example, there are many ways to implement a Bayesian algorithm). The theoretical framework plays a central role in the proposal and in the execution of the MICrONS program by guiding the design and interpretation of experiments, analyses, models, and algorithms. Throughout the program, performers will inform, refine, revise, (dis)prove and/or disambiguate various aspects of the framework and the brain's specific implementation thereof, so that they can build machine learning algorithms in that mold. Offerors are given wide latitude in proposing a theoretical framework so long as the framework is fundamentally compatible with existing neuroscience data and known biophysical processes. In describing the framework, proposals must specify:

- The "objective function" or mathematical "organizing principle" of the framework (e.g., statistical optimality, template matching, minimizing free energy, etc.);
- The overall processing architecture of the framework (e.g., parallel execution of multiple instances of a computing module, sequential execution of a family of transformations, etc.);
- The way data is represented within the framework (e.g., deterministic, probabilistic, sparse code, dense code, etc.);
- The key transformations of data or operations performed by the framework (e.g., feature extraction, normalization, probabilistic sampling, etc.);
- The rules that govern supervised and unsupervised learning in the framework (e.g., locally-driven learning, propagated error signals, etc.);
- The role of top-down and lateral feedback during perception and learning in the framework (e.g., gain modulation, feature selectivity, normalization, etc.);
- Likely neural mechanisms (connectivity and dynamics) that implement the supposed representations, transformations, and learning rules;
- Existing neuroscience data supporting the framework, with appropriate citations;
- What new information about the structure and function of mesoscale cortical circuits is required to create a highly-proficient machine learning algorithm consistent with this framework (with reference to the following sections on neural data acquisition and analysis and computational neural modeling); and
- How such an algorithm will differ from and outperform existing machine learning paradigms.[16]

[14] Offerors are encouraged to explore multiple different theoretical frameworks if they are deemed equally plausible and if they can be disambiguated through a common set of data.

[15] If the offeror believes that the proposed framework applies to multiple sensory domains, it is important to specify whether the same domain will be used for the planned experimental/modeling and algorithmic/machine learning work, and if not, how results will be translated between the two domains.

[16] It is acceptable to propose an algorithmic framework that is broadly consistent with one or more classes of existing machine learning algorithms if the offeror believes that knowledge of the specific configuration or parameterization of the brain's implementation of the framework is required to achieve brain-like performance.

IARPA does not expect the initial formulation of the framework to be veridical. Rather, the framework is intended to guide the design of experiments, algorithms, and analyses, and to define a space of hypotheses that can be disambiguated and refined by the results. Performers will revise the framework over the course of the program to accommodate new results and insights from the data acquisition, computational neural modeling, and machine learning activities.

1.C.1.b Use of Neural Data

Proposals must describe the structural and functional data on mesoscale neural circuits that the offeror will acquire (or specify to be acquired by another performer in TA2) in each phase of the program[17] and describe how the offeror's analysis of that data will advance their theory of cortical computing and inform their development and implementation of neurally-derived machine learning algorithms (Section 1.C.1.e). Offerors must clearly define their proposed experiments and indicate how they will use the different data products (from all three TAs) to select from among alternatives within a space of hypotheses about the representations, transformations, and learning rules employed by the cortical area(s) under study. Offerors must also specify how they will incorporate their findings into the computational neural models and how they will use the results to influence the design of their machine learning algorithms. The following sections provide additional details on required elements of this part of the proposal.

1.C.1.b(i) Model organism and region of interest

There is ongoing scientific debate about the uniformity of cortical processing, and MICrONS makes no assumptions in this regard. Offerors must therefore specify which region(s) of sensory cortex in which mammalian model organism(s) they will interrogate. Each proposal must articulate a clear justification for this choice in terms of its relevance to the proposed theoretical framework. When possible and sensible, offerors are encouraged to select brain regions that span multiple stages of processing to facilitate understanding of feed-forward and feedback connections between stages.

1.C.1.b(ii) Experiment design

Proposals must describe the experimental paradigm(s) that offerors will use to study the operation and organization of mesoscale cortical circuits. Both behavioral paradigms and/or non-behavioral *in vivo* paradigms (such as anesthetized preparations) may be used; in either case, the proposal must justify the choice in the context of the neuroscientific questions being asked about cortical computing. Risks and risk mitigation strategies must be specified for critical or particularly risky aspects of the experimental design.

1.C.1.b(iii) Supplementary data

In addition to collecting high-resolution data on mesoscale cortical circuits, offerors may propose a limited set of additional targeted data collection activities at other (smaller and/or larger) scales. This supplementary data may be collected *in vivo* or *in vitro*, may interrogate the same or different model organism and region of interest, may rely on measurements of structure and/or function at scales ranging from dendritic spines to the entire brain, may sample sparse or pooled

[17] At minimum, the proposed data must meet the specifications given in Table 4 and Table 5.

measurements of neural activity or connectivity, and may use any combination of appropriate experimental techniques and technologies. Proposals must provide a justification for each proposed supplementary data collection exercise that specifically describes how the offeror will use the results to inform the development and implementation of the machine learning algorithm and why this data is essential for achieving the goals of the program.

1.C.1.b(iv) Data analysis

Proposals must specify the computational and statistical methods the offeror will use to analyze the rich functional data and neural circuit reconstructions generated in each phase, including any new methods the offeror will develop for this program. Of particular interest are new graph-theoretic methods for identifying structural properties and circuit motifs of mesoscale neural circuits, and new dimensionality reduction methods for understanding patterns of activity in dense recordings of individual neurons. Proposals must describe the anticipated data products from key analyses and indicate how the offeror will use the results to constrain the computational neural models or to directly inform the machine learning algorithms. Offerors must highlight the major conceptual and/or technical challenges associated with their approach and specify a plan of research that addresses these challenges.

1.C.1.c Neurophysiological Data Collection

Offerors must describe the experimental techniques they will employ to acquire and process the neurophysiological data that they propose to collect. At minimum, these techniques must support recovery of information about the activity of the majority of individual neurons in a given sample volume with multiple measurements per neuron per second (Table 4) and document the associated (time-varying) sensory and behavioral state of the animal. Offerors must also describe how they will support the preparation of samples for neuroanatomical data collection in TA2 (Section 1.C.2.a) and enable performers in TA3 to co-register this functional data with the structural data to be acquired in TA2 (Section 1.C.3.b).

IARPA anticipates that existing technologies can be scaled up to meet the neurophysiological data acquisition targets in each phase (Table 4), but offerors may propose to develop new technologies that have exceptional promise for exceeding these targets if they can be expected to mature within the program timeline. Of particular interest are technologies that can monitor activity across all cortical layers simultaneously during behavior. For all technology development efforts proposed, offerors must specify key risks and associated mitigations.

Given the potential for the neurophysiological data sets to be very large, offerors must describe and propose solutions (and associated costs) for any technical or logistical challenges in moving data from the point of collection to their designated or selected data storage facility.

1.C.1.d Computational Neural Models

Offerors must describe the set of computational neural models that they will develop in Phase 1 to identify plausible neural mechanisms for the proposed representations, transformations, and learning rules (Section 1.C.1.a) and to yield insights into how the experimentally targeted cortical regions perform these (or different) functions. For each model, proposals must indicate:

- Which aspect(s) of cortical computing the model will inform or test;[18]
- How results from the model will help to refine the space of hypotheses regarding the brain's representations, transformations, and learning rules;
- How the analysis of the model will influence the design of the machine learning algorithm;
- How the design, operation, and or/performance of the machine learning algorithm will influence subsequent revisions of the model;
- How the offeror will use results from the model to guide the interpretation of data acquired in Phase 1 (e.g., if the model will generate any verifiable predictions);
- How the offeror will use results from the model to refine the design of experiments in Phase 2;
- The level of abstraction and biological detail to be modeled;[19]
- The approximate number of neurons, neuron types, and/or neural populations to be modeled;
- The approximate circuit architecture (including the organization of bottom-up inputs, lateral interactions, and top-down feedback) to be modeled;
- Any prominent dynamics to be modeled;
- Which aspects of the model (if any) are supported by existing data;[20] and
- How the offeror will use the structural and functional data acquired in Phase 1 to update the model in Phase 2 (e.g., if the updated models will reflect the detailed morphologies of reconstructed neurons, observed circuit motifs, etc.).

Offerors must also describe any anticipated challenges in scaling their models to accommodate the substantial increase in neural data and constraints available in Phases 2 and 3, and specify a plan of research that addresses these challenges.

1.C.1.e Machine Learning Algorithm

Offerors must specify their designs for new machine learning algorithms that use neurally-inspired architectures and mathematical abstractions of the representations, transformations, and learning rules employed by the brain to achieve brain-like performance. The designs must be consistent with the offeror's proposed theoretical framework for sensory information processing (Section 1.C.1.a). The algorithm is not required to explicitly represent biological elements like neurons and spikes (although it is acceptable to do so), but its mathematical abstractions must respect neurobiological constraints and be substantiated by a corresponding set of computational

[18] As long as the overall set of models is comprehensive, offerors may choose to develop a single monolithic model that incorporates all of the assumed representations, transformations, and learning rules; or multiple models that individually explore different (or partially overlapping) aspects of cortical computing.

[19] Offerors are encouraged to model circuits with the minimal complexity required to explain or inform the associated computation(s). Note, however, that all simplifications must be supported by the relevant neuroanatomy and neurophysiology. Whenever possible, the selected mechanism should be substantiated by the existing neuroscience literature or by new data collected in this program.

[20] Reasonable speculation is encouraged in the design of models, but they should be demonstrably consistent with new experimental data or existing published results and not violate any known principles of neuroanatomy or neurophysiology.

neural models.[21] For the initial version of the algorithm to be developed in Phase 1, proposals must include:

- A high-level overview of the planned implementation;
- An annotated illustration of the algorithm's major components;
- A mathematical formulation of the following aspects of the algorithm's design (with reference to Section 1.C.1.a):
    - The way in which the algorithm represents data,
    - The key data transformations or operations performed by the algorithm,
    - The supervised and unsupervised learning rules employed by the algorithm, and
    - The role of top-down and lateral feedback in the algorithm;
- A description of how the offeror will use the proposed neuroscience data and computational neural models to inform this formulation;
- A description of how the offeror will use practical considerations in implementing the algorithm to guide the design and interpretation of computational neural models and neuroscience experiments;
- A description of the algorithm's supporting (possibly non-neural) methods or modules such as preprocessing stages, output layers, linking operations, parameter tuning functions, etc.;
- A description of how the algorithm will be "trained," if necessary (see Section 1.B.1.a for details);
- A description of closely related existing neural or non-neural algorithms and the limitations of these algorithms in performing the tasks defined in Section 1.B.1.a and other complex information processing tasks; and
- A description of how the proposed algorithm, in its final form, will overcome these limitations.

In addition, the proposal must define a strategy for demonstrating correspondence between the computational neural models elucidating the brain's representations, transformations, and learning rules and the mathematical abstractions of these functions employed by the machine learning algorithm.

1.C.2 Guidance for Technical Area 2

1.C.2.a Neuroanatomical Data Collection

Offerors must describe the experimental techniques they will employ to acquire neuroanatomical data that can elucidate the operation of mesoscale cortical circuits. Included in the scope of this work is sample preparation (in collaboration with TA1), data collection, and post-processing. The specific brain region and tissue sample from which neuroanatomical data will be collected will be defined and provided by TA1 (Section 1.C.1.b), but all data collected in TA2 must meet

[21] The biological fidelity of the algorithms is limited to those functions that are presumed to be performed by cortical circuits. For example, performers are not required to develop neuromimetic memory structures to emulate the hippocampus.

the specifications given in Section 1.B.2.a.[22] At minimum, this data must support the recovery of information about the connectivity between neurons (at the resolution of individual synapses) and the morphology of neurons (Table 5). Offerors must also describe how they will enable performers in TA3 to co-register this structural data with the functional data to be acquired in TA1.

IARPA anticipates that existing technologies can be scaled up to meet the data acquisition targets in each phase (Table 5), but offerors may propose to develop new technologies that have exceptional promise for exceeding these targets if they can be expected to mature within the program timeline.[23] For all technology development efforts proposed, offerors must specify key risks and associated mitigations.

Given the potential for the neuroanatomical data sets to be very large, offerors must describe and propose solutions (and associated costs) for any technical or logistical challenges in moving data from the point of collection to their designated or selected data storage facility.

1.C.3 Guidance for Technical Area 3

1.C.3.a Neural Circuit Reconstruction

Proposals must describe the offeror's approach to generating quantitative descriptions of the morphology and connectivity of all neurons in the neuroanatomical data collected in TA2. Offerors may propose any combination of automated, semi-automated, and manual techniques as long as the resulting reconstructions meet the specifications defined in Section 1.B.3.b. Offerors who propose to TA3 *and not* TA1 or TA2 must specify the types of neuroanatomical data for which their approach is appropriate. All offerors must highlight the major conceptual and/or technical challenges associated with their approach and specify a plan of research (which may involve iterative or collaborative work with the other TAs) that addresses these challenges.

In addition to describing the technical approach to reconstruction, proposals must also describe how the offeror will represent the products of this work, i.e. whether the reconstructions will be in the form of skeletonized neurons, full volumetric annotations, neural graphs of nodes and edges, all of the above, etc. Offerors who propose to TA3 *and not* TA1 should consider that different scientific objectives may require different representations, and indicate the flexibility (if any) of their proposed approach in this regard.

1.C.3.b Co-registration of Functional and Structural Data

Proposals must specify how the offeror will identify a correspondence between the neurophysiological and neuroanatomical data acquired in TA1 and TA2, respectively, so that the observed neural activity can be assigned to specific locations in the structural data and to specific cell bodies or cellular processes in the neural circuit reconstruction. Included in the scope of this

[22] Offerors who propose to TA2 and *not* to TA1 should assume for planning and estimating purposes that they will collect data on the minimum tissue volumes specified in Table 5.

[23] Of particular interest are technologies that can augment structural data with information about receptor and/or ion channel distributions, technologies that can preserve the interstitial spaces between neural processes in structural images, and technologies that permit the use of conventional microscopes to image neural morphology and synaptic connectivity across large tissue samples.

effort is aligning data across samples within a given data modality (e.g., aligning multiple sections of an image stack from serial electron microscopy). Offerors who propose to TA3 *and not* TA1 or TA2 must specify the types of data for which their approach is appropriate. All offerors must highlight the major conceptual and/or technical challenges associated with their approach and specify a plan of research that addresses these challenges.

1.C.3.c Neural Data Storage

Proposals must describe the organization and structure of the database(s) that the offeror intends to design and use to store co-registered functional data, experimental annotations, structural data, and neural circuit reconstructions, so that they may be efficiently accessed for analysis by performers in the other TAs and by IARPA (for T&E purposes). Offerors who propose to TA3 *and not* TA1 or TA2 must specify the types of data, analyses, and access patterns for which their approach is appropriate, describe how their design supports these use cases, and indicate the flexibility of their proposed approach to accommodate emergent needs in the other TAs. Offerors who propose to all three TAs must describe how their approach supports the use case specified in their response to Section 1.C.1.b. All offerors must highlight the major conceptual and/or technical challenges associated with their approach and specify a plan of research that addresses these challenges.

1.C.3.d Neural Data Access

Proposals must describe how the offeror intends to provide their collaborators in other TAs and the T&E team with remote access to the stored structural data, functional data, and neural circuit reconstructions. Offerors must specify the software they intend to design and deploy for any client-side or server-side processes, and provide a sketch of the software interface they propose to provide to users. At a minimum, the offeror's proposed functionality must be sufficient to support the operations described in Section 1.B.3.c. Offerors who propose to TA3 *and not* TA1 or TA2 must specify the types of data for which their approach is appropriate. All offerors shall describe a development plan that includes the timing and expected features of intermediate software builds.

Although the information technologies developed for this task are only required to support "trusted users" (e.g., collaborators and the T&E team), IARPA ultimately intends to make some or all of the co-registered structural and functional neural data and neural circuit reconstructions available to the general scientific community.

1.C.4 Dependencies, Restrictions, and Interactions Between TAs

As described in Section 1.A.5, the success of the MICrONS program will depend on multidisciplinary collaborations within and across TAs. All proposals must therefore include a description of the offeror's management plan as well as a "technical interaction matrix." The management plan (Section 4.B.1.c(viii)) describes the team's organizational structure and communications plan. The technical interaction matrix specifies how the offeror's proposed technical approach in each TA is likely to impact the other TAs (e.g., any requirements levied on or required of the other TAs); any risks associated with the exchange of information, data, or tissue between TAs; and how the offeror plans to mitigate those risks. Examples of interactions that may be included in the technical interaction matrix include (but should not be limited to):

- For offerors to TA1
    - Whether the offeror plans to prepare brain tissue for neuroanatomical data collection in TA2, or if the offeror will simply make the tissue available for preparation by performers in TA2.
    - How the offeror's proposed methodology for neurophysiological data collection (Section 1.C.1.c) may interfere with collection of neuroanatomical data in TA2 (Section 1.C.2.a).
- For offerors to TA2
    - How the choice of a specific model organism and brain region by TA1 (Section 1.C.1.b(i)) may affect the offeror's protocol and procedures for collecting neuroanatomical data (Section 1.C.2.a), and how much "practice" and lead time the offeror needs to prepare for data collection.
    - How the offeror may alter their sample preparation to facilitate neural circuit reconstruction in TA3 (Section 1.C.3.a).
    - How the offeror's requirements for sample preparation may limit the scope or otherwise interfere with the collection of neurophysiological data in TA1 (Section 1.C.1.c).
- For offerors to TA3
    - How the specific parameters of the data collection methodology defined in TA2 (Section 1.C.2.a) may affect the offeror's approach to neural circuit reconstruction in TA3 (Section 1.C.3.a).
    - How the specific designs of the experimental behavioral paradigms defined in TA1 (Section 1.C.1.b(ii)) may affect their approach to storing and providing access to the associated functional data (Sections 1.C.3.c and 1.B.3.c, respectively).

IARPA expects that the T&E team will play an active role in facilitating interactions between TAs within and across teams.

1.C.5 Out of Scope

The following work is outside the scope of the MICrONS program:

- Experimental studies of non-mammalian systems;
- Experimental studies of non-cortical areas, except in cases of compelling scientific need;
- Experiments using cell culture;
- Sacrificing non-human primates, except in cases of compelling scientific need (see Section 4.B.1.d(vi) for details);
- Development of neuromorphic hardware, unless it is essential for developing and/or testing computational neural models or machine learning algorithms; and
- Basic research in neuroscience tool development.

SECTION 2: AWARD INFORMATION

The MICrONS program is envisioned as a 5-year effort. This BAA will result in awards for a Base Period for MICrONS Phase 1 (18 months), with options for Phase 2 (24 months) and Phase 3 (18 months). Funding for each Option Period will depend upon performance during the preceding period, as well as on program priorities, the availability of funding, and IARPA priorities. Funding of Option Periods is at the sole discretion of the Government. Performers considered for funding in the Option Periods will be those teams that have made significant technical and programmatic progress in the preceding period and have correctly understood and contributed to the overarching goals of the program. Depending on performance, technical evaluations, availability of funding, and IARPA priorities, performers that fail to demonstrate such progress, or that offer only minor improvements above the current state of the art, will not be invited to continue with the program.

The Government reserves the right to select for negotiation all, some, one or none of the proposals received in response to this solicitation and to make awards without discussions with offerors. The Government also reserves the right to conduct exchanges with the offerors if the Source Selection Authority determines them to be necessary. Additionally, IARPA reserves the right to accept proposals in their entirety or to select only portions of proposals for negotiations for award. In the event that IARPA desires to award only portions of a proposal, negotiations may be opened with that offeror.

Awards under this BAA will be made to offerors on the basis of the evaluation criteria listed in Section 5.A, program balance, and availability of funds. Proposals selected for negotiation may result in a procurement contract. However, the Government reserves the right to negotiate the type of award instrument it determines appropriate under the circumstances.

Offerors whose proposals are selected for negotiations will be contacted before award to obtain additional information required for award. The Government may establish a deadline for the close of fact-finding and negotiations that allows a reasonable time for the award of a contract. Offerors that are not responsive to Government deadlines established and communicated with the request may be removed from award consideration. Offerors may also be removed from award consideration should the parties fail to reach agreement on contract terms, conditions, and cost/price within a reasonable time.

SECTION 3: ELIGIBILITY INFORMATION

3.A Eligible Applicants

All responsible sources capable of satisfying the Government's needs may submit a proposal. Historically Black Colleges and Universities (HBCUs), Small Businesses, Small Disadvantaged Businesses and Minority Institutions (MIs) are encouraged to submit proposals and join others in submitting proposals; however, no portion of this announcement will be set aside for these organizations' participation due to the impracticality of reserving discrete or severable areas for exclusive competition among these entities. Other Government Agencies, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), Government-Owned, Contractor-Operated (GOCO) 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.

Non-U.S. entities and/or individuals may participate to the extent that such participants comply with any necessary Non-Disclosure Agreements, Security Regulations, Export Control Laws, and other governing statutes applicable under the circumstances.

3.A.1 Procurement Integrity, Standards of Conduct, Ethical Considerations and Organizational Conflicts of Interest (OCI)

"Organizational conflict of interest" means that, because of other activities or relationships with other persons, a person is unable or potentially unable to render impartial assistance or advice to the Government, or the person's objectivity in performing the contract work is or might be otherwise impaired, or a person has an unfair competitive advantage.

If a prospective offeror, or any of its proposed subcontractor teammates, believes that a potential conflict of interest exists or may exist (whether organizational or otherwise), the offeror shall promptly raise the issue with IARPA and submit a waiver request by e-mail to the mailbox address for this BAA at dni-iarpa-baa-14-06@iarpa.gov. All waiver requests must be submitted through the offeror, regardless of whether the waiver request addresses a potential OCI for the offeror or one of its subcontractor teammates. A potential conflict of interest includes, but is not limited to, any instance where an offeror, or any of its proposed subcontractor teammates, is providing either scientific, engineering and technical assistance (SETA) or technical consultation to IARPA. In all cases, the offeror shall identify the contract under which the SETA or consultant support is being provided. Without a waiver from the IARPA Director, neither an offeror, nor its proposed subcontractor teammates, can simultaneously provide SETA support or technical consultation to IARPA and compete or perform as a Performer under this solicitation.

All facts relevant to the existence of the potential conflict of interest, real or perceived, must be disclosed in the waiver request. The request must also include a proposed plan to avoid, neutralize or mitigate such conflict. The offeror, or subcontractor teammate as appropriate, shall certify that all information provided is accurate and complete, and that all potential conflicts, real or perceived, have been disclosed. It is recommended that an offeror submit this request as soon as possible after release of the BAA before significant time and effort are expended in preparing

a proposal. If, in the sole opinion of the Government, after full consideration of the circumstances, the conflict situation cannot be resolved, the request for waiver will be denied, and any proposal submitted by the offeror that includes the conflicted entity will be withdrawn from consideration for award.

As part of their proposal, offerors who have identified any potential conflicts of interest shall include either an approved waiver signed by the IARPA Director or a copy of their waiver request. Otherwise, offerors shall include in their proposal a written certification that neither they nor their subcontractor teammates have any potential conflicts of interest, real or perceived. A sample certification is provided in APPENDIX D.

If, at any time during the solicitation or award process, IARPA discovers that an offeror has a potential conflict of interest, and no waiver request has been submitted by the offeror, IARPA reserves the right to immediately withdraw the proposal from further consideration for award.

Offerors are strongly encouraged to read "Intelligence Advanced Research Projects Activity's (IARPA) Approach to Managing Organizational Conflicts of Interest (OCI)," found on IARPA's website at: http://www.iarpa.gov/index.php/working-with-iarpa/iarpas-approach-to-oci

3.B U.S. Academic Organizations

According to Executive Order 12333, as amended, paragraph 2.7, "Elements of the Intelligence Community are authorized to enter into contracts or arrangements for the provision of goods or services with private companies or institutions in the United States and need not reveal the sponsorship of such contracts or arrangements for authorized intelligence purposes. Contracts or arrangements with academic institutions may be undertaken only with the consent of appropriate officials of the institution."

It is highly recommended that offerors submit with their proposal a completed and signed Academic Institution Acknowledgement Letter for each U.S. academic organization that is a part of their team, whether the academic organization is serving in the role of prime, or a subcontractor or consultant at any tier of their team – this paperwork ***must*** be received before IARPA can enter into any negotiations with any offeror when a U.S. academic organization is a part of its team. A template of the Academic Institution Acknowledgement Letter is enclosed in this BAA at APPENDIX A. It should be noted that an appropriate senior official from the institution, typically the President, Chancellor, Provost, or other appropriately designated official must sign the completed form.

3.C Collaboration and Teaming

Collaborative efforts and teaming among potential performers are strongly encouraged prior to proposal submission. Offerors who propose to all three Technical Areas (TAs) shall comprise an integrated, multidisciplinary team with expertise and experience in theoretical neuroscience, computational neuroscience, neurophysiology, neuroanatomy, connectomics, computer science, and data science. After selection, performers who did not propose to all three TAs should be prepared to enter into collaborative relationships with performers in the other TAs, such that each performer is part of at least one group that encompasses all three TAs. In all cases, communications within and across TAs are the sole responsibility of the participants.

SECTION 4: PROPOSAL AND SUBMISSION INFORMATION

This notice constitutes the total BAA and contains all information required to submit a proposal. No additional forms, kits, or other materials are required.

4.A Content and Form of Proposal Submission

4.A.1 Proposal Information

Interested offerors are required to submit full proposals in order to receive consideration for funding. Full proposals shall include a Base Period of 18 months (Phase 1), a first Option Period of 24 months (Phase 2), and a second Option Period of 18 months (Phase 3). Offerors must describe a consolidated effort across all three phases; disjointed efforts should not be included in a single proposal. Proposals must be received by the time and date specified in Part One of this announcement to be considered during the initial round of selections.

All administrative correspondence and questions regarding this solicitation should be directed by email to dni-iarpa-baa-14-06@iarpa.gov. Proposals must be submitted in accordance with the procedures provided in Section 4.C.

4.A.2 Proposal Format

All pages shall be formatted for printing on 8-1/2 by 11 inch paper with type not smaller than 12 point and at least one-inch (1") margins on all sides. Foldout pages shall not be used. For tables, charts, graphs, and figures, the text shall be no smaller than 10 point (this includes any text within an illustration). The page limitations specified in Section 4.B include all figures, tables, and charts unless otherwise noted. All pages must be numbered. Unnecessarily elaborate brochures or presentations beyond what is sufficient to present a complete and effective proposal are not acceptable. Nonconforming proposals may be rejected without review.

4.B Proposal Content

Each proposal submitted in response to this BAA shall consist of the following:

Volume 1 – Technical and Management Proposal

Section I – Cover Sheet, Transmittal Letter, and Table of Contents
Section II – Executive Summary
Section III – Detailed Proposal
Section IV – Attachments
- 1 – Academic Institution Acknowledgment Letter(s) (recommended)
- 2 – Restrictions on Intellectual Property Rights (required)
- 3 – OCI Waiver/Certification (required)
- 4 – Bibliography (required)
- 5 – Animal Use Documentation (required)
- 6 – Non-human Primate Justification (required for use of non-human primates)
- 7 – Relevant Papers (optional)
- 8 – Consultant Commitment Letters (if needed)

Volume 2 – Cost Proposal

Section I – Cover Sheet
Section II – Detailed Estimated Cost Breakdown

All proposals must contain all of the elements enumerated above.

4.B.1 Volume 1: Technical and Management Proposal

As described above, proposal Volume 1 (Technical and Management Proposal) includes the cover sheet, transmittal letter, table of contents, executive summary, detailed proposal, and attachments. Page limits for the executive summary and detailed proposal are specified in Sections 4.B.1.b and 4.B.1.c, respectively. There is no page limit for attachments. Any pages exceeding the specified limits will be removed and not considered during the evaluation process. Any additional or supplemental materials beyond those specified below will also be removed. All proposals must be written in English.

4.B.1.a Section I: Cover Sheet, Transmittal Letter, and Table of Contents

Section I shall comprise a cover sheet, an official transmittal letter, and a table of contents. The official transmittal letter and table of contents may use the offeror's preferred format. The cover sheet must use the template provided in APPENDIX B.

4.B.1.b Section II: Executive Summary

Section II shall provide an overview of the proposed work, to be supplemented with a more detailed plan in Section III of the proposal. The Executive Summary shall specify which TA(s) the offeror is proposing to, and shall include the elements specified in the sections below. The page limit for the executive summary is computed as follows: start with five (5) pages and subtract two (2) pages if not proposing to TA1; subtract one (1) page if not proposing to TA2; and subtract one (1) page if not proposing to TA3.[24] In addition to the written summary, all offerors shall include a set of six (6) PowerPoint slides that conform to the specifications given in Section 4.B.1.b(vii).

4.B.1.b(i) Innovative claims

This section must succinctly describe the uniqueness and benefits of the proposed approach relative to the state of the art and alternate technologies and approaches.

4.B.1.b(ii) Key deliverables

This section must provide a summary of the specific work products to be delivered at the end of each phase of the program (e.g., a particular machine learning algorithm, neuroanatomical data from a given region of cortex, the design of a software system for neural data access, etc.). Offerors shall also describe any notable systems, models, analyses, methods, or results they will generate in the course of program execution (e.g., advanced neuroimaging technologies, graph theoretic analyses, novel four-dimensional data stores, etc.) Any restrictions on intellectual

[24] For example, an offeror proposing to TA1 and TA2 should have an executive summary that is no more than 5 – 1 = 4 pages long. An offeror proposing to TA3 only should have an executive summary that is no more than 5 – 2 – 1 = 2 pages long.

property rights or proprietary claims to the results, prototypes, intellectual property, or systems supporting and/or necessary for the use of the research, results, and/or prototypes must be summarized here and described in detail in Attachment 2. If there are no proprietary claims, this must be stated.

4.B.1.b(iii) Technical approach and plan

This section must provide an overview of the motivation, technical approach, and execution plan for realizing the innovations and outcomes described in the previous two sections. The offeror shall include a timeline of the proposed research illustrating the beginning and end of key experiments and analyses; the offeror-defined milestones; expected dates of delivery or receipt of critical data, information, tissue samples, etc.; and the anticipated timing of other major technical developments. If the offeror is not proposing to all three TAs, they must clearly indicate any dependencies on work products from other teams.

4.B.1.b(iv) Previous related research

This section must summarize the offeror's previous related work in the relevant TAs that is germane to the MICrONS program and to their specific proposed approach.

4.B.1.b(v) Key personnel and management plan

This section must enumerate key personnel and specify their proposed level of effort, expected role(s) on the program, and relevant expertise (see Table 8 for an example). It shall also define the relationships among team members and outline the team's leadership structure and internal communications plan.

Table 8: Key personnel and significant contributors

Participant	Organization	Role	Expertise	LOE
Jane Doe	ABC University	Co-PI	Theoretical neuroscience	60%
John Doe	XYZ Company	Co-PI	Machine learning	60%
Mike Moe	ABC University	Project Manager	Neurophysiology	80%
Bill Boe	JCI Consulting	Math consultant (individual)	Graph theory	20%

4.B.1.b(vi) Cost summary

This section must list the overall proposed cost, the proposed cost per phase, and any planned cost sharing (if applicable). Offerors must also indicate how these costs are apportioned across prime contractors, subcontractors, and consultants (if any) in each phase, and break out costs associated with major equipment purchases or procurements of information technology cloud services.

4.B.1.b(vii) Slides

The offeror must include a set of six (6) slides in MS PowerPoint or PDF format that succinctly excerpt the most important information from the written Executive Summary. Each of the six topics enumerated in Sections 4.B.1.b(i)–4.B.1.b(vi) must be described on a single slide. The

slides may use graphics or illustrations that are not part of the written summary, but may not introduce any new substantive content. These slides may be used during the evaluation process to present a summary of the proposal from the proposer's view.

4.B.1.c Section III: Detailed Proposal

The Detailed Proposal shall provide an in-depth discussion of the proposed research, as well as supporting information about the offeror's capabilities and resources. The Detailed Proposal shall clearly state which TA(s) the offeror is proposing to, and shall include the elements specified in the sections below. The page limit for the detailed proposal is computed as follows: start with fifty (50) pages and subtract thirty (30) pages if not proposing to TA1; subtract five (5) pages if not proposing to TA2; and subtract five (5) pages if not proposing to TA3.[25]

4.B.1.c(i) Research Plan

This section is the centerpiece of the proposal. Offerors should follow the guidance provided in Section 1.C and consider the evaluation criteria specified in Section 5.A when formulating and describing their research plans. All research plans must contain detailed descriptions of the offeror's specific objectives, technical approaches, and expected outcomes; provide a comparison of the proposed approach to other on-going research and to the existing state of the art; identify the advantages and disadvantages of the proposed approach relative to potential alternative approaches; provide justification as to why the proposed approach is feasible; describe any anticipated risks and possible mitigations; and highlight the uniqueness of the proposed approach. Proposals that address only one or a few of the program objectives, metrics, and/or deliverables in the relevant TAs will be deemed non-responsive, as will proposals that lack specific detail in describing the technical approach.

4.B.1.c(ii) Statement of Work (SOW)

This section must contain clear descriptions of the technical tasks and sub-tasks to be performed, their durations, and the dependencies among them, in plain English and without specifying any proprietary information. Offerors must define tasks that can be performed prior to receiving IACUC approval, as IARPA will not permit work on tasks involving animal research until the appropriate approvals are granted. For each task and sub-task, offerors shall provide:

- The TA to which it pertains;
- A general description of the objective;
- References to the relevant portions of the research plan supporting this objective;
- Identification of the primary organization responsible for task execution (prime, subcontractor, team member, etc.) by name;
- The exit criteria for each task/activity (i.e., a product, event, waypoint, or milestone that defines its completion);
- Definition of all deliverables (e.g., data, reports, software, etc.) to be provided to the Government in support of the proposed task.

[25] For example, an offeror proposing to TA1 and TA2 may have a detailed proposal that is no more than 50 – 5 = 45 pages long. An offeror proposing to TA3 only may have a detailed proposal that is no more than 50 – 30 – 5 = 15 pages long.

At the end of this section, the offeror shall provide a Gantt chart showing all the tasks and sub-tasks on the left with the performance period (in years/quarters) on the right. All milestones must be clearly labeled on the chart in addition to expected dates of completion of key experiments, analyses, and technical developments; and expected dates of delivery and receipt for critical data, information, tissue samples, etc. If the offeror is not proposing to all three TAs, the chart must clearly indicate any dependencies on work products from other teams.

4.B.1.c(iii) Deliverables

Offerors shall describe the form and expected content of deliverables they will produce for program waypoints, milestones, and events (Section 1.B.4), to include all data, models, algorithms, analyses, system documentation, reports, presentations, and publications. For deliverables with offeror-defined metrics or target values, offerors shall explain each of the metrics and use a table such as Table 9 to summarize their expected performance at designated waypoints and milestones. For all software, performers shall include executables, system design files, and source code produced in the course of software development for the delivered version, in addition to any scripts, libraries, release notes, and other associated components, data, or documentation. All technical deliverables shall meet or exceed the specifications and objectives described in Section 1.B. For data that is to be "delivered" by providing access to a remote storage server, the offeror must describe a mechanism by which such data may be transferred to a Government facility or to a Government-procured account on a commercial cloud service provider.[26] Every deliverable must be delivered prior to the end of the contract Period of Performance in which it was due.

The Government requires Government Purpose Rights (GPR)[27] at a minimum, and prefers unlimited rights, for all deliverables, including all neurophysiological data, neuroanatomical data, neural circuit reconstructions, and associated software systems to access and visualize such data (Section 1.C.3). In Attachment 2 of the proposal, the offeror must describe their proposed approach to intellectual property for all deliverables, together with a supporting rationale of why this approach is in the Government's best interest. If the offeror asserts limited or restricted rights in any deliverable or component(s) of a deliverable, the proposal must identify the potential cost for the Government to obtain GPR in the deliverable. Proposals that do not include this information will be considered non-compliant and may not be reviewed by the Government. See Sections 4.B.1.d(ii) and 6.B.2 for additional details.

[26] Offerors shall include the cost of data transfer as a contract option in their proposal.

[27] "Government Purpose Rights" is defined here as the rights to use, modify, reproduce, release, perform, display, or disclose technical data and computer software within the Government without restriction; and to release or disclose technical data and computer software outside the Government and authorize persons to whom release or disclosure has been made to use, modify, reproduce, release, perform, display, or disclose that data or software for any United States Government purpose. United States Government purposes include any activity in which the United States Government is a party, including cooperative agreements with international or multi-national defense organizations, or sales or transfers by the United States Government to foreign governments or international organizations. Government purposes include competitive procurement, but do not include the rights to use, modify, reproduce, release, perform, display, or disclose technical data or computer software for commercial purposes or authorize others to do so.

Table 9: Sample table of metrics and performance targets at program waypoints and milestones

Metric	Target			
	Waypoint 1.3	**Milestone 1.A**	**Milestone 1.B**	**Waypoint/Milestone *N***
Neurophysiological data acquisition				
Spatial extent	250 x 250 x 50 μm^3	500 x 500 x 100 μm^3	N/A	
Spatial resolution	1 x 1 x 10 um^3	1 x 1 x 10 um^3	N/A	
Temporal resolution	7.5 Hz	7.5 Hz	N/A	
Recording density	60%	70%	N/A	
Offeror-specified 1			N/A	
Offeror-specified 2			N/A	
Neuroanatomical data acquisition				
Spatial extent	50 x 50 x 50 μm^3	N/A	100 x 100 x 100 μm^3	
Spatial resolution	4 x 4 x 50 nm^3	N/A	4 x 4 x 30 nm^3	
Acquisition rate	100 μm^3 / sec	N/A	500 μm^3 / sec	
Offeror-specified 1		N/A		
Co-registration of structural and functional data				
Worst-case alignment	1 um	N/A	N/A	
Neural circuit reconstruction				
Synapse detection				
Precision	60%	N/A	N/A	
Recall	60%	N/A	N/A	
NID	95/65/40 @ 30/50/90	N/A	N/A	
Morph. accuracy		N/A	N/A	
Offeror-specified 1		N/A	N/A	
Neural data analysis				
Offeror-specified				

4.B.1.c(iv) Data Sources

Offerors must identify and describe the sources of all data that they intend to use during the course of the program. Offerors proposing to use existing data sets must provide written verification that all data were obtained in accordance with U.S. laws and, where applicable, are in compliance with End User License Agreements, Copyright Laws, Terms of Service, and laws and policies regarding privacy protection of U.S. Persons. Offerors providing existing data sets to the Government as a deliverable must ensure that the Government has at least GPR in such data sets or provide an estimate of the cost to the Government to obtain GPR in such data sets. Offerors proposing to obtain new data sets must ensure that their plan for obtaining the data complies with U.S. Laws and, where applicable, with End User License Agreements, Copyright Laws, Terms of Service, and laws and policies regarding privacy protection of U.S. Persons. The Government reserves the right to reject a proposal if it does not appropriately address all data issues.

If the proposed research involves laboratory animals, the offeror must include complete Institutional Animal Care and Use Committee (IACUC) research protocols as Attachment 5 (Section 4.B.1.d(v)) and refer to Section 6.B.4 for additional information. If the proposed research involves the use of non-human primates, the offeror must additionally complete Attachment 6 (Section 4.B.1.d(vi)). IARPA does not expect the research to involve human subjects research. If human subjects research is necessary, the offeror must notify IARPA as soon as possible by sending email to dni-iarpa-baa-14-06@iarpa.gov.

4.B.1.c(v) Cost

Offerors must provide the overall cost for the proposed research, the cost per phase, and estimates of the cost for each deliverable and for each task described in the SOW. All costs shall indicate the overall value; the cost of any major equipment purchases or procurements of information technology cloud services; and the allocations to the prime, subcontractors, and consultants. As described in Section 1.C, offerors who do not propose to all three TAs must specify their preferred commercial cloud service provider for data storage and large-scale data analyses and include all associated costs based on published rates.

Offerors shall specify any facilities, equipment, or materials they propose to provide to support the research effort at no additional cost to the Government (i.e., cost sharing).[28] Proposals shall also indicate the type of support, if any, the offeror might request from the Government, such as facilities, equipment, or materials. Where the effort consists of multiple portions that could reasonably be partitioned for purposes of funding, these shall be identified as options with separate cost estimates for each.

4.B.1.c(vi) Previous and Related Research

Offerors shall describe their previous accomplishments and ongoing work in this research area and in closely related research areas, and explain how these experiences will contribute to and influence the research proposed here. Offerors must also identify any other federal, state, and/or

[28] Cost sharing is not required from offerors and is not an evaluation criterion, but is encouraged where there is a reasonable probability of leveraging the investment for other research efforts or potential commercial applications related to the proposed research.

local agencies or other parties receiving the proposal and/or funding the proposed effort, or indicate that there are none.

4.B.1.c(vii) Facilities

Offerors shall describe the facilities that will be used for the proposed effort, including computational and experimental resources. If any of these facilities will not be available for use by the time of contract award, this must be clearly indicated and the offeror shall provide a timeline of expected availability, any risks associated with delays or setup of the new facility, and mitigation strategies in case the risks are realized.

4.B.1.c(viii) Detailed Management Plan

All offerors must define management plans that provide for regular communication among all team members; promote efficient and effective dissemination and discussion of ideas and results across disciplines; and describe planning, scheduling, and control practices. Offerors who propose to fewer than all three TAs must additionally define a plan for collaborating with teams performing in the other TAs.

Offerors must include an organizational chart of all anticipated team members (with organizational affiliations) and the relationships between team members, to include technical, administrative, and business personnel; project/function/subcontractor relationships (including formal teaming agreements); and Government research interfaces. If the team intends to use consultants, they must be included in the organizational chart as well.[29] Offerors shall provide a description of all team members' responsibilities, their expected levels of effort (as percentage of time or FTE fraction), brief biographical sketches of key personnel and significant contributors, and detailed descriptions of the role(s) that each individual will play based on their qualifications and on their level of effort in each phase of the program. This information should also be summarized in a table using a format similar to that of Table 8. Participation by key personnel and significant contributors is expected to exceed 20% of their time. If any such participant is scheduled for less than 20% of his/her time, the offeror must provide a clear and compelling justification as to how benefit can be gained from that person's participation at the specified level of effort.

Individuals and/or organizations may participate in multiple proposals. For example, an individual or organization may propose to TA2 in one or more proposals that include TA1 and/or TA3 in their scope, and may propose to TA2 only in a separate proposal.

4.B.1.d Section IV: Attachments

Offerors that include a U.S. academic organization as part of their team are strongly encouraged to include Attachment 1 in their proposal. Attachments 2–5 are required from all offerors. Attachment 6 is required for any offeror that proposes to conduct research using non-human

[29] Indicate if each consultant person will be an "individual" or "organizational" consultant (that is, if the consultant will represent himself/herself or his/her organization). In either case, the consultant's organizational affiliation should be identified. The consultant should make a written commitment of their participation on the team; this commitment letter may be included in Section IV, Attachment 8 of the proposal Volume 1.

primates. Attachment 7 is optional for all offerors. Attachment 8 is required for any offeror who intends to utilize consultants. There is no page limit for attachments.

4.B.1.d(i) *Attachment 1: Signed Academic Institution Acknowledgement Letter(s)*

The Academic Institution Acknowledgement letter template is provided as APPENDIX A. Note that this paperwork ***must*** be received before the Government can enter into any negotiations with any offeror when a U.S. academic organization is a part of its team. See Section 3.B for additional details.

4.B.1.d(ii) *Attachment 2: Restrictions on Intellectual Property Rights*

If the offeror (including its proposed teammates) desires to use in its proposed approach, in whole or in part, technical data, computer software, or both that is proprietary to the offeror, any of its teammates, or any third party, in Attachment 2 the offeror shall: (1) clearly identify such data and/or software and its proposed particular use(s); (2) identify and explain any and all restrictions on the Government's ability to use, modify, reproduce, release, perform, display, or disclose technical data, computer software, and deliverables incorporating such technical data and computer software; (3) identify the potential cost to the Government to acquire GPR in all deliverables that use the proprietary technical data or computer software the offeror intends desires to use; (4) explain how the Government will be able to reach its program goals (including transition) within the proprietary model offered; and (5) provide possible nonproprietary alternatives in any area in which Government agencies would have insufficient rights to transfer, within the Government or to Government contractors, deliverables incorporating proprietary technical data or computer software, or that might cause increased risk or cost to the Government under the proposed proprietary solutions.

The offeror shall also use Attachment 2 to enumerate any and all proprietary claims to the results, prototypes, intellectual property, or systems supporting and/or necessary for the use of the research, results, and/or prototypes. To the greatest extent feasible, offerors should not include background proprietary technical data and computer software as the basis of their proposed technical approach. If the offeror proposes the use of any open source or freeware, any conditions, restrictions or other requirements imposed by that software must also be addressed in Attachment 2. Should no proprietary claims be made, Government rights will be unlimited.

Offerors must utilize the format in APPENDIX G for their response. The technical content of Attachment 2 shall include only the information necessary to address the proposed approach to intellectual property; any other technical discussion in Attachment 2 will not be considered during the evaluation process. IARPA recognizes only the definitions of intellectual property rights in accordance with the terms as set forth in the Federal Acquisition Regulation (FAR) Part 27, or the Department of Defense FAR Supplement (DFARS) Part 227. If offerors propose intellectual property rights that are not defined in FAR Part 27 or DFARS Part 227, offerors must clearly define such rights in Attachment 2 of their proposal. Offerors are reminded of the requirement for prime contractors to acquire sufficient rights from subcontractors to accomplish the program goals. See Section 6.B.2 for additional details.

4.B.1.d(iii) Attachment 3: OCI Waiver Request or Certification

The OCI Waiver Request or Certification template is provided as APPENDIX D. See Section 3.A.1 for additional details.

4.B.1.d(iv) Attachment 4: Bibliography

Offerors shall include a bibliography of relevant technical papers and research notes (published and unpublished) that document the technical ideas on which the proposal is based. All references in the bibliography should be cited in the detailed proposal (Section III).

4.B.1.d(v) Attachment 5: Animal Use Documentation

Offerors must include a complete draft of any Institutional Animal Care and Use Committee research protocol applications (including any appendices and addenda) required to conduct the proposed research in Phase 1. IARPA expects that performers will obtain the necessary approvals within three (3) months of contract award; any anticipated deviations from this schedule must be described in the proposal. If the offeror plans to conduct human subjects research, they must notify IARPA as soon as possible by sending email to dni-iarpa-baa-14-06@iarpa.gov.

4.B.1.d(vi) Attachment 6: Non-human Primate Justification

Non-human primate (NHP) model systems offer a potentially rich source of experimental insights to guide the development of algorithms that exhibit human-like performance on complex information processing tasks. However, the phylogenic proximity of NHPs to humans is not in and of itself sufficient to justify their use in MICrONS. Offerors who seek to use NHPs in the course of their research must provide justification for this choice by describing which aspects of the proposed research could not be performed adequately using lower mammalian species (e.g., mice, rats, shrews, cats, etc.) and why these aspects are necessary to achieve the program's goals. If the offeror proposes to sacrifice NHPs, they must additionally describe which aspects of the proposed research would be affected if sacrificing NHPs were not permitted and how this restriction would affect the offeror's ability to achieve program objectives.

4.B.1.d(vii) Attachment 7: Relevant Papers

Offerors may include copies of not more than three (3) relevant papers as Attachment 7.

4.B.1.d(viii) Attachment 8: Consultant Commitment Letter(s)

If the offeror intends to utilize any consultants, each consultant must make a written commitment of their participation on the team using his/her preferred format.

4.B.2 Volume 2: Cost Proposal

4.B.2.a Section I: Cover Sheet

The cover sheet must use the template provided in APPENDIX C.

4.B.2.b Section II: Estimated Cost Breakdown

The estimated cost breakdown shall include the following elements:

(1) Cost element breakdown for the overall effort, base period, and each option period for the offeror and each subcontractor, using the templates provided in APPENDIX E and APPENDIX F. Educational institutions (prime and subcontractor level) may request authorization from the Contracting Officer during the period when questions are accepted on this BAA (see Part One of this announcement) to deviate from the cost templates for proposing direct labor hours and rates to be consistent with OMB guidance when estimating the direct labor costs;
(2) Total cost broken down by major task;
(3) Major program tasks by fiscal year;
(4) Proposed subcontract costs and equipment purchases;
(5) Proposed purchase of any information technology (IT) or procurement of any IT cloud services;
(6) A summary of projected funding requirements by month;
(7) The source, nature, and amount of organizational cost-sharing, if any; and
(8) Identification of pricing assumptions that may require incorporation into the resulting award instrument (e.g., use of Government Furnished Property/Facilities/Information, access to Government Subject Matter Experts, etc.).

The prime contractor is responsible for compiling and providing all subcontractor proposals. All subcontractor proposals shall include burdened rates in the cost breakdown listed above. If a proposal is selected for negotiations, both the prime and subcontractors must be prepared to present full cost proposals including all direct and indirect rates immediately upon request by the Contracting Officer. Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options with separate cost estimates for each. For non-IT[30] equipment purchases, offerors shall include a letter stating why

[30] "Information Technology" is defined as "any equipment, or interconnected system(s) or subsystem(s) of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the agency. (a) For purposes of this definition, equipment is used by an agency if the equipment is used by the agency directly or is used by a contractor under a contract with the agency which – (1) Requires the use of such equipment; or (2) Requires the use, to a significant extent, or such equipment in the performance of a service or the furnishing of a product. (b) The term "information technology" includes computers, ancillary software, firmware and similar procedures, services (including support services), and related resources. (c) The term "information technology" does not include – (1) Any equipment that is acquired by a contractor incidental to a contract; or (2) Any equipment that contains imbedded information technology that is used as an integral part of the product, but the principal function of which is not the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. For example, HVAC (heating, ventilation, and air conditioning) equipment, such as thermostats or temperature control devices, and medical equipment where information technology is integral to its operation, is not information technology."

the requested resources cannot be provided by the offeror's own funding. For IT purchases, offerors shall include a letter stating why the requested resources cannot be provided by the offeror's own funding and why it is in the Government's best interest for these resources to be acquired rather than procured as a cloud service. As described in Section 1.C, offerors who do not propose to all three TAs must specify their preferred commercial cloud service provider for data storage and large-scale data analyses and include the associated costs based on published rates.

Supporting cost and pricing information must be provided in sufficient detail to substantiate the summary cost estimates in Volume 1. Include a description of the method used to estimate costs and supporting documentation such as forward pricing rate agreements, certifications of approved purchasing systems, etc. Key personnel must be listed by name for the prime and all subcontractors.

Consultant letter(s) of commitment shall be attached to the Cost Volume and estimated costs must be included in the cost estimates.

4.C Submission Details

4.C.1 Due Date

Proposals must be received by the time and date specified in Part One of this announcement in order to be considered during the initial round of selections. IARPA *may* evaluate proposals received after the initial due date until the BAA closing date specified in Part One of this announcement. Selection remains contingent on proposal evaluation, program balance and availability of funds.

4.C.2 Proposal Delivery

Proposals must be submitted electronically through the IARPA Distribution and Evaluation System (IDEAS). **Offerors interested in providing a submission in response to this BAA must first register by electronic means in accordance with the instructions provided on the following website: https://iarpa-ideas.gov. Offerors who plan to submit proposals are strongly encouraged to register at least one week prior to the due date in the initial round of selections.** Offerors who do not register in advance do so at their own risk, and IARPA will not extend the due date for proposals to accommodate such offerors. Failure to register as stated will prevent the offeror's submission of documents.

After registration has been approved, offerors shall upload proposals, including Volume 1, Volume 2, scanned certifications, and permitted additional information. Offerors are responsible for ensuring compliant and final submission of their proposals to meet the BAA submittal deadlines. Time management to upload and submit is wholly the responsibility of the offeror.

Upon completing the proposal submission the offeror will receive an automated confirmation email from IDEAS. IARPA strongly suggests that the offeror document the submission of their proposal package by printing the electronic receipt (time and date stamped) that appears on the final screen following compliant submission of a proposal to the IDEAS website.

Proposals submitted by any means other than the Proposal Submission Website at https://iarpa-ideas.gov (e.g., hand-carried, postal service, commercial carrier and email) will not be considered unless the offeror attempted electronic submission, but was unsuccessful. Should an offeror be unable to complete the electronic submission, the offeror must send an e-mail to dni-iarpa-baa-14-06@iarpa.gov prior to the proposal due date and time specified in the BAA indicating that an attempt was made to submit electronically but that the submission was unsuccessful. This e-mail must include contact information for the offeror. Additional guidance will be provided in response.

Failure to comply with the submission procedures may result in the submission not being evaluated.

4.D Funding Restrictions

Facility construction costs are not allowable under this activity. Funding may not be used to pay for commercialization of technology.

SECTION 5: PROPOSAL REVIEW INFORMATION

5.A Evaluation Criteria

Five criteria, as defined below, will be used to evaluate and select proposals for this BAA. In descending order of importance, the criteria are: Overall Scientific and Technical Merit, Effectiveness of Proposed Work Plan, Contribution and Relevance to the IARPA Mission and Program Goals, Relevant Experience and Expertise, and Cost Realism. Because there is no common statement of work, each proposal will be evaluated on its own merits and its relevance to the program goals rather than against other proposals responding to this BAA. Note that award(s) will be made to offerors on the basis of the evaluation criteria listed below, program balance, and availability of funds. Award recommendations will not be made to offerors whose proposals are determined to be not selectable.

Overall Scientific and Technical Merit

- The 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.

Effectiveness of Proposed Work Plan

- The feasibility and likelihood that the proposed approach will 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 offeror decisions and/or Government decisions.
- The schedule to achieve the milestones is realistic and reasonable.
- The roles and relationships of prime and subcontractors are clearly delineated with all participants fully documented.
- Work plans 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 demonstrate that key personnel have sufficient time committed to the program to accomplish their described program roles.
- The team has a well-defined management structure and internal communication plan.

- The requirement for and the anticipated use or integration of Government Furnished Property (GFP) including all equipment, facilities, information, etc., is fully described including dates when such GFP, Government Furnished Equipment (GFE), Government Furnished Information (GFI), or other similar Government-provided resources will 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 to support transition of the Program results to Intelligence Community users at a reasonable cost.

Contribution and Relevance to the IARPA Mission and Program Goals

- The proposed solution meets the letter and intent of the MICrONS program goals.
- All elements within the proposal exhibit a comprehensive understanding of the program.
- 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 over its future adversaries.
- The proposed approach to intellectual property rights is in the Government's best interest.

Relevant Experience and Expertise

- The offeror has a unique combination of capabilities, related experience, facilities, and techniques that may be used to achieve the proposal's objectives.
- The proposed principal investigator, team leader, and key personnel critical in achieving the proposal objectives have a unique combination of qualifications, capabilities, and experience.
- Time commitments of key personnel are sufficient for their proposed responsibilities in the effort.

Cost Realism[31]

- The proposed costs are realistic for the work proposed. Estimates are "realistic" when they are neither excessive nor insufficient for the effort to be accomplished.
- The proposal documents all anticipated costs including those of associate, participating organizations.
- The proposal demonstrates that the offeror has fully analyzed budget requirements and addressed resulting cost risks.
- Other sponsors who have funded or are funding this offeror for the same or similar efforts are identified.

[31] IARPA recognizes that undue emphasis on cost may motivate offerors to offer low-risk ideas with minimum uncertainty and to staff the effort with junior personnel in order to be in a more competitive posture. IARPA discourages such cost strategies. Cost reduction approaches that will be received favorably include innovative management concepts that maximize direct funding for technology and limit diversion of funds into overhead. After selection and before award, the Contracting Officer will negotiate cost/price reasonableness.

- All cost data are traceable and reconcilable.
- Equipment, software, and data collection expenses are well justified.
- Travel, especially foreign travel, is well justified and required for successful execution of the proposed work.

5.B Use of Non-Government Advisors

The Government intends to use employees of Booz Allen Hamilton, Scitor, Johns Hopkins University Applied Physics Laboratory, Sandia National Laboratory, and the Institute for Defense Analyses to provide expert advice regarding portions of the proposals submitted to the Government. Booz Allen Hamilton and Scitor will also provide logistical support in carrying out the evaluation process. These personnel will have signed and be 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 must 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 will assume consent to the use of contractor support personnel in assisting the review of submittal(s) under this BAA.

Only Government personnel will make evaluation and award determinations under this BAA.

5.C Review and Selection Process

IARPA's policy is to ensure impartial, equitable, comprehensive proposal evaluations and to select the source (or sources) whose offer meets the Government's technical, policy and programmatic goals. In order to provide the desired evaluation, qualified Government personnel will conduct reviews and (if necessary) convene panels of experts in the appropriate areas.

IARPA will only review proposals against the criteria described in Section 5.A, and will not evaluate them against other proposals, because they are not submitted in accordance with a common work statement. For evaluation purposes, a proposal is the document described in Section 4. Other supporting or background materials submitted with the proposal that are not requested in Section 4 will not be considered.

5.D Proposal Retention

IARPA's policy is to treat all proposals as competitive information and to disclose their contents only for the purpose of evaluation. Proposals will not be returned upon completion of the source selection process. Rather, the original of each proposal received will be retained at IARPA and all other non-required copies will be destroyed. A certification of destruction may be requested, provided that the formal request is sent to IARPA via e-mail within 5 days after notification of proposal results.

SECTION 6: AWARD ADMINISTRATION INFORMATION

6.A Award Notices

As soon as the evaluation of a proposal is complete, the offeror will be notified that: (1) the proposal has been selected for negotiations, or (2) the proposal has not been selected.

6.B Administrative and National Policy Requirements

6.B.1 Proprietary Data

It is the policy of IARPA to treat all proposals as competitive information, and to disclose their contents only for the purpose of evaluation. All proposals containing proprietary data must have the cover page and each page containing proprietary data clearly marked as containing proprietary data. It is the offeror's responsibility to *clearly define* to the Government what is considered proprietary data.

Performers may use their own data for development purposes as long as they follow the guidelines in Section 6.B.12.

6.B.2 Intellectual Property

6.B.2.a Noncommercial Items (Technical Data and Computer Software)

Offerors responding to this BAA shall identify in Volume 1, Section IV, Attachment 2 of the proposal all noncommercial technical data and noncommercial computer software that it plans to generate, develop and/or deliver under any proposed award instrument in which the Government will acquire less than unlimited rights and to assert specific restrictions on those deliverables, the basis for such restrictions, and the intended use of the technical data and noncommercial computer software in the conduct of the proposed research and development of applicable deliverables. If Offerors intend to incorporate noncommercial, proprietary technical data or computer software into any deliverable, Offerors shall provide in Volume 1, Section IV, Attachment 2 of their proposals all of the information regarding such proprietary technical data or computer software as described in Section 4.B.1.d(ii) of this BAA.

In the event that offerors do not submit such information, the Government will assume that it automatically has unlimited rights to all noncommercial technical data and noncommercial computer software generated, developed, and/or delivered under any award instrument, unless it is substantiated that development of the noncommercial technical data and noncommercial computer software occurred with mixed funding. If mixed funding is anticipated in the development of noncommercial technical data and noncommercial computer software generated, developed and/or delivered under any award instrument, then offerors shall identify the data and software in question and that the Government will receive GPR in such data and software. The Government will automatically assume that any such GPR restriction is limited to a period of five years, at which time the Government will acquire unlimited rights unless the parties agree otherwise.

Offerors are advised that the Government will use this information during the source selection evaluation process to evaluate the impact of any identified restrictions and may request additional information from the offeror, as may be necessary, to evaluate the offeror's assertions. If no restrictions are intended, then the offeror must state "NONE." A sample format for complying with this request is shown in APPENDIX G.

For all technical data and computer software that the offeror intends to deliver with other than unlimited rights that are identical or substantially similar to technical data and computer software that the offeror has produced for, delivered to, or is obligated to deliver to the Government under any contract or subcontract, the offeror shall identify the contract number under which the data, software, or documentation were produced; the contract number under which, and the name and address of the organization to whom, the data and software were most recently delivered or will be delivered; and any limitations on the Government's rights to use or disclose the data and software, including, when applicable, identification of the earliest date the limitations expire.

6.B.2.b Commercial Items (Technical Data and Computer Software)

Offerors responding to this BAA shall identify in Section IV, Attachment 2 of the proposal a list of all commercial technical data and commercial computer software that may be incorporated in any noncommercial deliverables contemplated under the research effort, along with any applicable restrictions on the Government's use of such commercial technical data and/or commercial computer software. In the event that offerors do not submit the list, the Government will assume that there are no restrictions on the Government's use of such commercial items. The Government may use the list during the source selection evaluation process to evaluate the impact of any identified restrictions and may request additional information from the offeror, as may be necessary, to evaluate the offeror's assertions. If no restrictions are intended, then the offeror must state "NONE. A sample format for complying with this request is shown in APPENDIX G.

6.B.2.c Patents

Offerors shall include documentation (using the format provided in APPENDIX G) proving ownership of or possession of appropriate licensing rights to all patented inventions (or inventions for which a patent application has been filed) that will be utilized under the proposal for the MICrONS program. If a patent application has been filed for an invention that the proposal utilizes, but the application has not yet been made publicly available and contains proprietary information, the offeror may provide only the patent number, inventor name(s), assignee names (if any), filing date, filing date of any related provisional application, and a summary of the patent title, together with either: 1) a representation that the offeror owns the invention, or 2) proof of possession of appropriate licensing rights in the invention.

6.B.2.d Intellectual Property Representations

The offeror shall provide a good faith representation that they either own or possess appropriate licensing rights to all other intellectual property that will be utilized under their proposal for the MICrONS program.

6.B.3 Meeting and Travel Requirements

To facilitate cross-fertilization of ideas between teams, all performers will be expected to attend a Kickoff meeting and a Principal Investigator (PI) meeting in each phase of the program. These one- to two-day meetings will focus on technical aspects of the program and on facilitating open technical exchanges, interaction, and sharing among the various program participants. Performers will be expected to present the technical status and progress of their projects as well as demonstrate their technical, non-proprietary capabilities to other participants and invited guests at these events. For costing purposes, offerors should expect these meetings to be held in the Washington, D.C. metropolitan area.

At least once every twelve months, each performer will host the MICrONS Program Manager, Contracting Officer's Technical Representative, and selected program advisors for site visits at the performer's facility to enable IARPA to evaluate the team's progress in meeting technical and programmatic waypoints and milestones, and to review financial expenditures and plans. Reports on technical progress, details of successes and challenges, contributions to the program goals, and technology demonstrations will be expected at such visits.

A list of program events is provided in Table 7. For convenience, these dates have been integrated with the waypoints and milestones. Performers are expected to assume responsibility for travel to administer their projects and to comply with contractual and program requirements for reporting, attending program events, and participating in site visits.

6.B.4 Animal Care and Use

The offeror's care and use of any animals[32] in the course of the program must conform with the applicable laws of the United States, regulations of the Department of Agriculture (see 7 U.S.C. § 2131 et seq. and 9 C.F.R. subchapter A, parts 1-4), and the Department of Health and Human Service's Public Health Service Policy on Humane Care and Use of Laboratory Animals. Offerors shall acquire animals from dealers licensed by the Secretary of Agriculture under 7 U.S.C. § 2133 and 9 C.F.R. §§ 2.1 through 2.11, or from a source that is exempt from licensing under those sections.[33]

Institutions awarded funding for research involving animals must register with the Secretary of Agriculture in accordance with 7 U.S.C. § 2136 and 9 C.F.R. § 2.30 and furnish evidence of such registration to the Contracting Officer before undertaking work under this contract.[33] Performers shall maintain their registration and comply with the requirements of 9 C.F.R. part 2, subpart C throughout all phases of the program.

For all proposed research that will involve animals, the offeror must provide a copy of all research protocols in a form suitable for submission to the cognizant Institutional Animal Care and Use Committee(s) (IACUC) as Attachment 5 in proposal Volume 1 (Section 4.B.1.d(v)).

[32] The term "animal" shall have the meaning provided in 9 C.F.R. § 1.1.

[33] Offerors may request registration of their facility and obtain a current listing of licensed dealers from the Regional Office of the Animal and Plant Health Inspection Service (APHIS), USDA, for the region in which its research facility is located. The location of the appropriate APHIS Regional Office, as well as information concerning this program may be obtained by contacting the Animal Care Staff, USDA/APHIS, 4700 River Road, Riverdale, Maryland 20737 (E-mail: ace@aphis.usda.gov; Website: (http://www.aphis.usda.gov/animal_welfare/).

Consult the designated IACUC for guidance on writing the protocol. All Phase 1 IACUC protocols must be approved by the end of the third month in the base period of performance (Table 7). No IARPA funding can be used towards animal research until approval is granted by the Contracting Officer.

6.B.5 Publication Approval

It is anticipated that research funded under this program will be unclassified research that will not require a pre-publication review. However, performers should note that pre-publication approval of certain information may be required if it is determined that its release may result in the disclosure of sensitive intelligence information. A courtesy soft copy of any work submitted for publication must be provided to the IARPA Program Manager and the Contracting Officer Representative (COR) at least two weeks prior to submission, and a final copy must be provided upon publication.

6.B.6 Export Control

The offeror shall comply with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 C.F.R. Parts 120 through 130, and the Export Administration Regulations (EAR), 15 C.F.R. Parts 730 through 799, in the performance of this contract. In the absence of available license exemptions/exceptions, the offeror shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of (including deemed exports) hardware, technical data, and software, or for the provision of technical assistance.

The offeror shall be responsible for obtaining export licenses, if required, before utilizing non-U.S. persons (as defined in the ITAR and the EAR) in the performance of this contract, including instances where the work is to be performed on-site at any Government installation (whether in or outside the United States), where the non-U.S. person will have access to export-controlled technologies, including technical data or software.

The offeror shall be responsible for all regulatory record keeping requirements associated with the use of licenses and license exemptions/exceptions.

The offeror shall appropriately mark all contract deliverables controlled by ITAR and/or EAR.

The offeror shall be responsible for ensuring that the provisions of this Section 6.B.6 apply to its subcontractors.

The offeror will certify knowledge of and intended adherence to these requirements in the representations and certifications of the contract.

6.B.7 Subcontracting

It is the policy of the Government to enable small business and small disadvantaged business concerns to be considered fairly as subcontractors to contractors performing work or rendering services as prime contractors or subcontractors under Government contracts and to assure that prime contractors and subcontractors carry out this policy. Each offeror that submits a proposal that includes subcontractors, is selected for funding (pending negotiations), and has proposed a

funding level above the maximum cited in the FAR, may be asked to submit a subcontracting plan before award in accordance with FAR 19.702(a) (1) and (2). The plan format is outlined in FAR 19.704. Offerors must declare teaming relationships in their proposals and must specify the type of teaming arrangement in place, including any exclusive teaming arrangements. IARPA neither promotes, nor discourages the establishment of exclusive teaming agreements within offeror teams. Individuals or organizations associated with multiple teams must take care not to over-commit those resources being applied.

6.B.8 Reporting

Fiscal and management responsibility are important to IARPA. Although the number and types of reports will be specified in the award document, all performers will, at a minimum, provide the Contracting Office, Contracting Officer's Technical Representative, and the MICrONS Program Manager with monthly technical reports and monthly financial reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed upon before award. Technical reports will describe technical highlights and accomplishments, priorities and plans, issues and concerns; will provide evaluation results; and will detail future plans. Financial reports will present an on-going financial profile of the project, including total project funding, funds invoiced, funds received, funds expended during the preceding month and planned expenditures over the remaining period. Additional reports and briefing material may also be required, as appropriate, to document progress in accomplishing program metrics.

Performers will submit a final summary report of their work fifteen (15) working days prior to the conclusion of the performance period of the award (even if the research may continue under a follow-on vehicle). The final summary report will be delivered to the Contracting Agent, Contracting Officer's Technical Representative, and the MICrONS Program Manager. The final summary report will include the following elements, and may incorporate information from the deliverable reports specified in Section 1.B.1:

- Problem definition
- Findings and approach
- Possible generalizations and lessons learned
- Accomplishments against the program metrics and goals
- Information on performance limitations and potential mitigations
- Remaining challenges and anticipated path ahead
- Final list of all commercial, third party, or proprietary hardware, software, or technical data integrated into any deliverable and all applicable restrictions on the Government's use

6.B.9 System for Award Management (SAM)

Selected offerors not already registered in the Systems for Award Management (SAM) may be required to register in SAM prior to any award under this BAA. Information on SAM registration is available at http://www.sam.gov.

6.B.10 Representations and Certifications

Prospective offerors may be required to complete electronic representations and certifications at http://www.sam.gov. Successful offerors will be required to complete additional representations and certifications prior to award.

6.B.11 Internet Payment Platform (IPP)

Offerors will be required to submit invoices for payment directly via the Internet Payment Platform (IPP) at http://ipp.gov. Registration to IPP will be required for any award under this BAA.

6.B.12 Lawful Use and Privacy Protection Measures

All data gathered by performers must be obtained in accordance with U.S. laws and in compliance with the End User License Agreement, Copyright Laws, Terms of Service, and laws and policies regarding privacy protection of U.S. Persons. Before using such data, the performer must provide proof that the data was acquired in accordance with U.S. laws and regulations.

APPENDIX A

ACADEMIC INSTITUTION ACKNOWLEDGEMENT LETTER TEMPLATE

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

-- Please Place on Official Letterhead --

<insert date>

To: Mr. Thomas Kelso
Chief Acquisition Officer
ODNI/IARPA
Office of the Director of National Intelligence
Washington, D.C. 20511

Subject: Academic Institution Acknowledgement Letter

Reference: Executive Order 12333, As Amended, Para 2.7

This letter is to acknowledge that the undersigned is the responsible official of <insert name of the academic institution>, authorized to approve the contractual relationship in support of the Office of the Director of National Intelligence's Intelligence Advanced Research Projects Activity and this academic institution.

The undersigned further acknowledges that he/she is aware of the Intelligence Advanced Research Projects Activity's proposed contractual relationship with <insert name of institution> through IARPA-BAA-14-06 and is hereby approved by the undersigned official, serving as the president, vice-president, chancellor, vice-chancellor, or provost of the institution.

_____ _____

<Name> Date
<Position>

APPENDIX B

SAMPLE COVER SHEET

for

VOLUME 1: Technical and Management Proposal

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

(1) BAA number	IARPA-BAA-14-06
(2) Relevant Technical Areas	[1, 2, and/or 3]
(3) Lead organization submitting proposal	
(4) Type of business, selected from 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: title, first name, last name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)	
(9) Administrative point of contact, to include: title, first name, last name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)	
(10) Is Volume 1 compliant with all page limits?	Yes/No
(11) Have IP rights been addressed in accordance with Section 6.B.2? (See template in APPENDIX G; include as Attachment 2)	Yes/No
(11a) Are any limited or restricted rights asserted for non-commercial items?	Yes/No
(12) Is an OCI waiver or waiver request (Section 3.A.1) included?	Yes/No
(12a) If No, is written certification included? (See template in APPENDIX D; include as Attachment 3)	Yes/No
(13) Are one or more U.S. academic organizations part of your team?	Yes/No
(13a) If Yes, are you including an Academic Institution Acknowledgement Statement with your proposal for each U.S. academic organization that is part of your team? (See template in APPENDIX A; include as Attachment 1)	Yes/No
(14) Are complete IACUC research protocol application(s) included? (No template provided; include as Attachment 5)	Yes/No
(15) Total funds requested from IARPA and the amount of cost share (if any)	$
(16) Date proposal submitted	

APPENDIX C

SAMPLE COVER SHEET

for

VOLUME 2: Cost Proposal

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

(1) BAA number	IARPA-BAA-14-06
(2) Relevant Technical Areas	[1, 2, and/or 3]
(3) Lead organization submitting proposal	
(4) Type of business, selected from 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: title, first name, last name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)	
(9) Administrative point of contact, to include: title, first name, last name, street address, city, state, zip code, telephone, fax (if available), electronic mail (if available)	
(10) Award instrument requested: Cost-Plus-Fixed-Fee (CPFF), Cost-contract–No Fee, Cost Sharing Contract–No Fee, Grant, Cooperative Agreement, or other type of procurement contract (specify)	
(11) Place(s) and period(s) of performance	
(12) Total proposed cost separated by base award and option(s) (if any)	
(13) Name, address, telephone number of the offeror’s defense contract management agency (DCMA) administration office or equivalent cognizant contract administration entity, if known	
(14) Name, address, telephone number of the offeror’s defense contract audit agency (DCAA) audit office or equivalent cognizant contract audit entity, if known	
(15) Date proposal was prepared	
(16) DUNS number	
(17) TIN number	
(18) Cage code	
(19) Proposal validity period (minimum of 180 days)	
(20) Cost summaries (See templates in APPENDIX E and APPENDIX F)	
(21) Size of business, in accordance with NAICS Code <INSERT NAICS CODE HERE>	

APPENDIX D

ORGANIZATIONAL CONFLICTS OF INTEREST LETTER TEMPLATE

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

(Month DD, YYYY)

Office of the Director of National Intelligence
Intelligence Advanced Research Projects Activity (IARPA)
Office of Safe and Secure Operations
ATTN: R. Jacob Vogelstein
Washington, DC 20511

Subject: OCI Certification

Reference: MICrONS, IARPA-BAA-14-06, (Insert assigned proposal ID#, if received)

Dear Dr. Vogelstein,

In accordance with IARPA Broad Agency Announcement IARPA-BAA-14-06, Section 3.A.1 *Procurement Integrity, Standards of Conduct, Ethical Considerations, and Organizational Conflicts of Interest (OCI)*, and on behalf of _____ (offeror name) I certify that neither _____ (offeror name), nor any of our subcontractor teammates has a potential conflict of interest, real or perceived, as it pertains to the MICrONS program.

If you have any questions, or need any additional information, please contact (Insert name of contact) at (Insert phone number) or (Insert e-mail address).

Sincerely,

(Insert organization name)
(Must be signed by an official that has the authority to bind the organization)

(Insert signature)

(Insert name of signatory)
(Insert title of signatory)

APPENDIX E

SAMPLE PRIME CONTRACTOR COST ELEMENT SHEET

for

VOLUME 2: Cost Proposal

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

Complete a Cost Element Sheet for the Base Period and <u>each</u> Option Period

COST ELEMENT	BASE	RATE	AMT
DIRECT LABOR (List each labor category separately; identify Key Personnel by name)	Hrs	$	
TOTAL DIRECT LABOR			$
FRINGE BENEFITS	$	%	$
TOTAL LABOR OVERHEAD	$	%	$
SUBCONTRACTORS, IOTS, CONSULTANTS (List separately; see table below)			$
MATERIALS & EQUIPMENT (List each material and equipment item separately)	qty	$ unit price	$
SOFTWARE & INTELLECTUAL PROPERTY (List separately; see table below)	$	$	$
TOTAL MATERIALS & EQUIPMENT			$
MATERIAL OVERHEAD	$	%	$
TRAVEL (list each trip separately)	# of travelers	$ price per traveler	$
TOTAL TRAVEL			$
OTHER DIRECT COSTS (list each item separately)	qty	$ unit price	$
TOTAL ODCs			$
G&A	$	%	$
SUBTOTAL COSTS			$
COST OF MONEY	$	%	$
TOTAL COST			$
PROFIT/FEE	$	%	$
TOTAL PRICE/COST			$
GOVERNMENT SHARE, IF APPLICABLE			$
RECIPIENT SHARE, IF APPLICABLE			$

SUBCONTRACTORS/INTERORGANIZATIONAL TRANSFERS (IOT) & CONSULTANTS PRICE SUMMARY

A	B	C	D	E	F
SUBCONTRACTOR IOT & CONSULTANT NAME	**SOW TASKS PERFORMED ***	**TYPE OF AWARD**	**SUBCONTRACTOR, IOT & CONSULTANT QUOTED PRICE**	**COST PROPOSED BY PRIME FOR THE SUB-CONTRACTOR, IOT & CONSULTANT**	**DIFFERENCE (Column D - Column E) IF APPLICABLE**
TOTALS					

*Identify Statement of Work, Milestone or Work Breakdown Structure paragraph, or provide a narrative explanation as an addendum to this Table that describes the effort to be performed.

NOTE: Educational institutions (prime and subcontractor level) may deviate from the cost template, upon approval from the Contracting Officer, when estimating the direct labor portion of their proposal. This deviation may be permitted to allow for accounting methods that do not accumulate direct labor costs by hours and rates.

APPENDIX F

SAMPLE SUBCONTRACTOR COST ELEMENT SHEET

for

VOLUME 2: Cost Proposal

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

SUBCONTRACTOR COST ELEMENT SHEET [SAMPLE]			
Complete a cost element sheet for each applicable period			
COST ELEMENT	**BASE**	**BURDENED RATE**	**AMT**
DIRECT LABOR (list each labor category separately; identify key personnel by name)	# hrs	$	$
TOTAL DIRECT LABOR			$
SUBCONTRACTORS, IOTS, CONSULTANTS			$
MATERIALS & EQUIPMENT (list each material and equipment item separately)	qty	$ unit price	$
TOTAL MATERIALS & EQUIPMENT			$
TRAVEL (list each trip separately)	# of travelers	$ price per traveler	$
TOTAL TRAVEL			$
OTHER DIRECT COSTS (list each item separately)	qty	$ unit price	$
TOTAL OTHER DIRECT COSTS			$
TOTAL PRICE/COST			$

Software and intellectual property costs		
Item	**Cost**	**Date of expiration**
(List)		

NOTE: Educational institutions (prime and subcontractor level) may deviate from the cost template, upon approval from the Contracting Officer, when estimating the direct labor portion of their proposal. This deviation may be permitted to allow for accounting methods that do not accumulate direct labor costs by hours and rates.

APPENDIX G

RESTRICTIONS ON INTELLECTUAL PROPERTY RIGHTS

for

VOLUME 1: Technical and Management Proposal

IARPA Broad Agency Announcement (BAA)

MICrONS Program

IARPA-BAA-14-06

Noncommercial items (technical data and computer software)

NONCOMMERCIAL ITEMS			
Technical data, computer software to be furnished with restrictions	**Basis for assertion**	**Asserted rights category**	**Name of person asserting restrictions**
(LIST)	(LIST)	(LIST)	(LIST)

Description of restrictions on Government's ability to use, modify, reproduce, release, perform, display, or disclose technical data, computer software, and deliverables incorporating technical data and computer software listed above:

Potential cost to the Government to acquire GPR in all deliverables incorporating the technical data and computer software listed above:

Intended use of the technical data and computer software listed above in the conduct of the proposed research:

Commercial items (technical data and computer software)

COMMERCIAL ITEMS			
Technical data, computer software to be furnished with restrictions	**Basis for assertion**	**Asserted rights category**	**Name of person asserting restrictions**
(LIST)	(LIST)	(LIST)	(LIST)

Patents

PATENTS			
Patent number (or application number)	**Patent name**	**Inventor name(s)**	**Patent owner(s)**
(LIST)	(LIST)	(LIST)	(LIST)