



Broad Agency Announcement
Hierarchical Identify Verify Exploit (HIVE)
Microsystems Technology Office
DARPA-BAA-16-52
August 2, 2016

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ATTACHMENT 1: Proposer Cost Volume Checklist
ATTACHMENT 2: Proposal Summary Slide Template

PART I: OVERVIEW INFORMATION

- **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Microsystems Technology Office (MTO)
- **Funding Opportunity Title** – Hierarchical Identify Verify Exploit (HIVE)
- **Announcement Type** – Initial Announcement
- **Funding Opportunity Number** – DARPA-BAA-16-52
- **Catalog of Federal Domestic Assistance Numbers (CFDA)** – Not Applicable
- **Dates** (All times listed herein are Eastern Time)
 - Posting Date: August 2, 2016
 - Proposers Day: August 11, 2016
 - Abstract Due Date: September 2, 2016, 5:00 PM
 - FAQ Submission Deadline: October 5, 2016
 - Proposal Due Date: October 19, 2016, 5:00 PM
 - Estimated period of performance start: April 2017
- **Concise description of the funding opportunity:** The DARPA Microsystems Technology Office HIVE program is soliciting research proposals for the development of a generic and scalable graph processor specializing in processing sparse graph primitives. The program includes the development of chip prototypes, development of software tools to support programming of the new hardware, and design of a system architecture to support efficient multi-node scaling.
- **Anticipated individual awards** – Multiple awards are anticipated.
- **Anticipated funding type** – 6.2
- **Types of instruments that may be awarded** – Procurement contract or other transaction.
- **Agency contact**
 - Mr. Trung Tran, Program Manager
BAA Coordinator: DARPA-BAA-16-52@darpa.mil
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PROPOSERS ARE CAUTIONED THAT EVALUATION RATINGS MAY BE LOWERED AND/OR PROPOSALS REJECTED IF PROPOSAL PREPARATION (PROPOSAL FORMAT, CONTENT, ETC.) AND/OR SUBMITTAL INSTRUCTIONS ARE NOT FOLLOWED.

PART II: FULL TEXT OF ANNOUNCEMENT

I. Funding Opportunity Description

The Defense Advanced Research Projects Agency (DARPA) often selects its research efforts through the Broad Agency Announcement (BAA) process. This BAA is being issued, and any resultant selection will be made, using the procedures under Federal Acquisition Regulation (FAR) 35.016. Any negotiations and/or awards will use procedures under FAR 15.4. Proposals received as a result of this BAA shall be evaluated in accordance with evaluation criteria specified herein through a scientific review process.

DARPA BAAs are posted on the Federal Business Opportunities (FedBizOpps) website, <http://www.fbo.gov/>. The following information is for those wishing to respond to the BAA.

The Microsystems Technology Office at DARPA seeks innovative proposals for the development of a generic graph processor specializing in processing sparse graph primitives. The program includes the development of chip prototypes and the development of software tools to support programming of the new hardware. Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

A. Motivation and Overview

Today large amounts of data is collected from numerous sources, such as social media, sensor feeds (e.g. cameras), and scientific data. Graph analytics has emerged as a way to understand the relationships between these heterogeneous types of data, allowing analysts to draw conclusions from the patterns in the data and to answer previously unthinkable questions. By understanding the complex relationships between different data feeds, a more complete picture of the problem can be understood and some amount of causality may be inferred. Currently much of graph analytics is performed in large data centers on large cached or static data sets and the amount of processing required is a function of not only the size of the graph, but the type of data being processed. Since graph analytics is being increasingly applied to “needle in the haystack” types of problems, the nature of the graph can be very sparse, as the number of relationships between entities are not known or clear.

There is also an increasing need to make decisions in real time, which requires understanding how the inherent relationships in the graph evolve over time. Previous research has been done on streaming graph analytics, but has been hampered by the amount of processing required to pinpoint which part of the graph needs to be updated based on the new data. This update has to be done at the speed of the incoming data and cannot be done as an offline process because the nature of the graph is either developing or changing in real time.

The sparseness of the data and the requirement to process that data in real time make the application of graph analytics on standard processors extremely inefficient. The processing

workload has shifted to locating the information and moving the data, while the amount of time and power spent calculating results has shrunk to less than 4% of the overall effort. This inefficiency has either limited the size of the graph that can be addressed to only what can be held in the chip or requires an extremely large cluster of computers to make up for this inefficiency.

The goal of the HIVE program is to create a graph analytics processor that achieves 1000x improvement in processing efficiency. This will enable the relationships between events to be discovered as they unfold in the field rather than relying on forensic analysis in data centers. Further, data scientists will be able to make associations previously thought impractical due to the amount of processing required. The program includes the development of chip prototypes, development of software tools to support programming of the new hardware, and design of a system architecture to support efficient multi-node scaling. Specifically the chip development will focus on improving the efficiency of random access memory transactions to limit data movement, efficient parallelism to improve scalability, and new accelerators which are design specifically for graph computation.

B. Program Description

The HIVE program seeks to develop and integrate technologies that will lead to the development of a generic graph processor. The program will include three phases as seen in Figure #1:

1. An architectural development phase that will lead to the design of new memory controllers, new accelerators based on graph primitives, new data flow models, new data mapping tools, and new middleware which enables seamless transition of existing graph algorithms onto the new hardware.
2. A prototyping phase that will demonstrate the benefits of these new technologies on the typical Department of Defense (DoD) applications to ensure that the performance of the graph processor meets expectations.
3. A final fabrication phase that will demonstrate the scalable performance of a 16 node system comprised of custom graph processors for accelerating the most demanding DoD analytic missions.

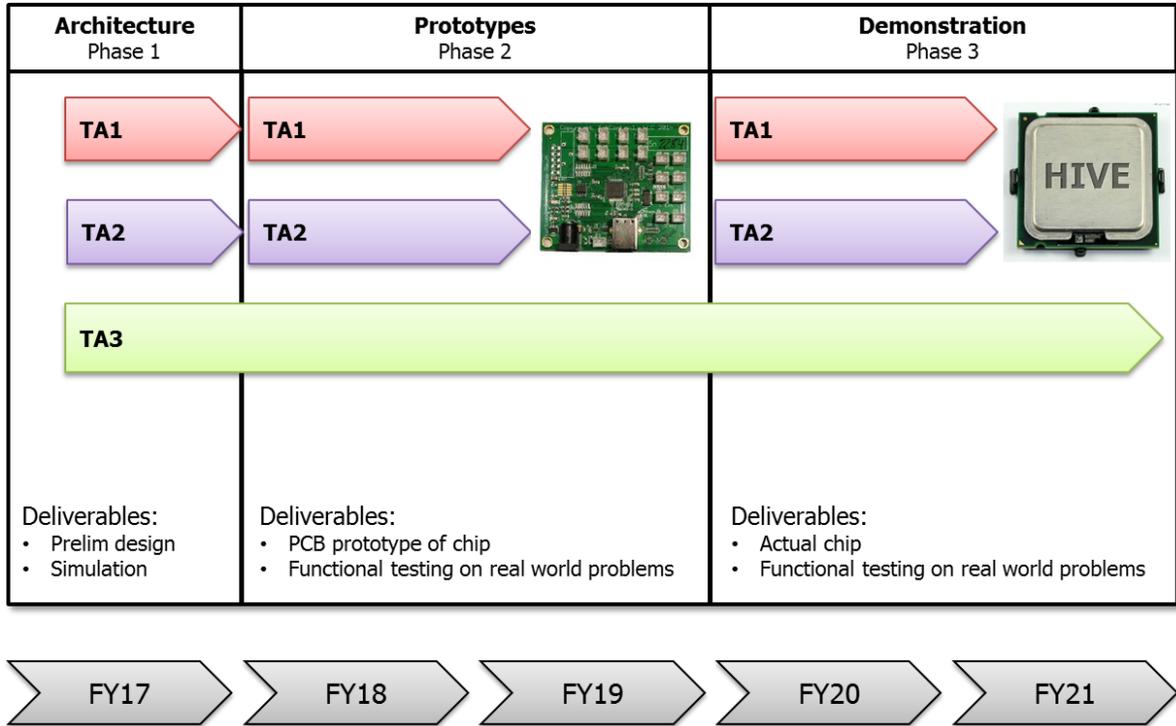


Figure #1: HIVE Phase Schedule

Successful proposals will recognize the need for hardware and software co-design and the need to fully understand the different applications that require graph analytics. This program is focused on research but strong consideration will be given to proposers with a clear transition path for their technologies, both within the DoD and commercially. Proposers are encouraged to participate in open source communities and forums which promote the use of graph analytics.

Proposals that address multiple Technical Areas (TAs) must ensure that they completely cover each area and the tasks associated with each TA should be clearly delineated. All proposals should describe a clear path to the final objectives.

Operation in a mission environment should be a key focus of the proposal for all TAs. Proposals should describe the thermal, electrical and mechanical constraints and potential uses for their architecture. Prototype devices and systems are expected to meet the performance objectives listed for their respective TAs. If proposed objectives are less aggressive than those defined herein, they will be considered only with justification and a sound path to meeting the final objectives, and if an appropriate risk mitigation plan is offered. The government may request that experimental results be independently verified at the end of each phase by testing at an approved government facility, at government expense. Performance data will be provided to the government prior to submitting the test article for evaluation at a DoD test lab.

DARPA seeks innovative proposals in the following three technical areasTAs:

1. Technical Area One (TA1): Graph Analytics Processor

The role of TA1 is to research and design a new chip architecture from scratch. Performers are intended to tackle the twin challenges of the memory wall and of true parallelization of multi-node systems. The memory wall has vexed programmers for the last 20 years and has forced them to come up with new and creative ways to deal with memory access and memory bandwidth bottlenecks, bottlenecks caused by serial memory access patterns relying on the uniform memory placement. New memory architectures are anticipated to be created to allow for non-uniform memory access (NUMA).

True parallelization has also been hampered by the ability to allow coherent memory accesses between nodes and the ability to allow for multi-master multi-drop bus architectures. This leads to machines running in parallel but running independently. True parallelization would allow for those machines to work more closely in concert. In essence, TA1 has to move from today's single instruction multi-data (SIMD) world to one that allows for multiple instruction multi-data (MIMD) execution.

A MIMD/NUMA architecture has been tried in the past but with limited success. HIVE aims to take advantage of new network on a chip busses, new memory architectures, and new input/output (I/O) structures to make that architecture a reality.

Phase 1: Architecture (12 month base period)

In the architectural phase of TA1, performers are expected to evaluate current graph algorithms and approaches in order to:

- a) Create an accelerator architecture and processor pipeline which supports the processing of identified graph primitives in a native sparse matrix format.
- b) Develop a chip architecture that supports the rapid and efficient movement of data from memory or I/Os to the accelerators based on an identified data flow model. Emphasis should be on redefining cache based architectures so that they address both sparse and dense data sets.
- c) Develop an external memory controller designed to ensure efficient use of the identified data mapping tools. The controller should be able to efficiently handle random and sequential memory accesses on memory transfers as small as 8 to 32 bytes.

The government will provide a set of initial primitives, an initial data flow model, and an initial data mapping based on known graph analytics algorithms for TA1 performers to use as a basis for their initial design. Using this data, TA1 performers should present an initial architecture and simulation tools which can be used by TA2 to develop the middleware software hooks needed to work with the new hardware architectures. This deliverable is shown in Figure #2.

Phase 2: Prototype (24 month option period)

In the prototype phase of TA1, it is intended that performers develop a printed circuit board (PCB) prototype of the new chip architecture, as well as any low level software needed to work with the TA2 tool software. The prototype will serve as an emulator of the future chip and can be done on a field-programmable gate array (FPGA) or any combination of existing silicon which is

able to demonstrate the new chip architectures developed in the first phase by TA1. This deliverable is shown in Figure #2.

Phase 3: Demonstration (18 month option period)

In the demonstration phase of TA1, performers should provide and make the adjustments required based on testing done in the prototype phase and proceed to fabricate, test and bring-up the new graph processing chip. TA1 performers should develop hardware, including appropriate interconnect and memory subsystems, to enable the testing of the chips in a 16 node configuration by TA3. This deliverable is shown in Figure #2.

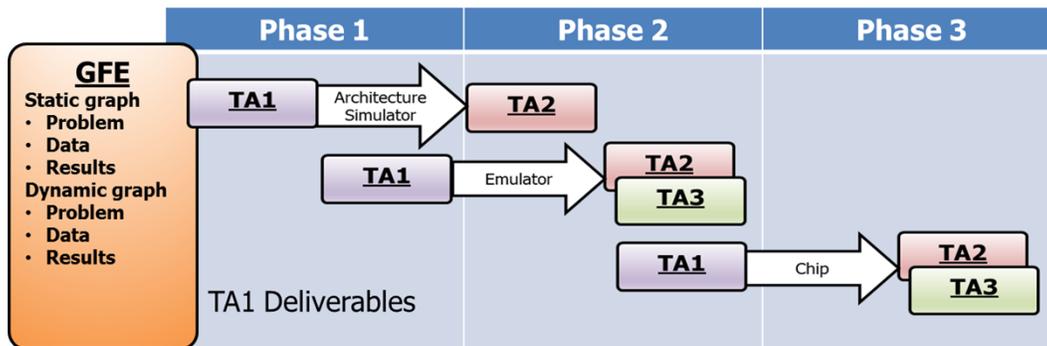


Figure #2: TA1 schedule of deliverables to TA2/3

2. Technical Area Two (TA2) Graph Analytics Toolkits

TA2 aims to develop the fundamental software technologies needed to translate existing graph algorithms into the new hardware being developed by TA1. Micro-code needs to be developed to match the microarchitecture of the chips developed by TA1. TA2 has to ensure that the micro-code is written in such a way as to support the data format and graph primitives required by existing graph algorithms and not force them to re-write their algorithms. This translation is extremely difficult because it requires balancing the needs of the hardware and at the same time ensuring ease of use for the software programmers.

Phase 1: Architecture (12 month base period)

In the architectural phase of TA2, performers are encouraged to evaluate current graph algorithms and approaches utilizing conventional central processing unit (CPU) and graphics processing unit (GPU) based hardware and software tools to:

- a) Create a list of graph primitives which are suitable for acceleration.
- b) Create a data flow model which evaluates the required bandwidths, data sizes, and access patterns which optimize the processing of the graph primitives.
- c) Identify data maps which map sparse graphs into available memory architectures and allow for easy retrieval of the data.

To drive initial design and analysis activities, the Government will provide a minimum of two challenge datasets to TA2 performers to evaluate. One will represent a static graph use case and the second will represent a dynamic graph (or streaming) use case. The provided challenge data

sets will include a mission statement, the raw data sets, suggested algorithm for analysis, and expected conclusions/answers. The challenge data sets will be similar in nature to the data sets provided under the VAST challenge (<http://hcil2.cs.umd.edu/newvarepository/benchmarks.php>), but will emphasize computational challenge as opposed to algorithmic development. TA2 performers should plan to provide TA1 performers the results of their work to inform the architecture of the hardware design. This is shown in Figure #3.

Phase 2: Prototype (24 month option period)

In the prototype phase of TA2, performers should develop software tools which enable rapid and intuitive conversion of current commercially available algorithms as well as government algorithms developed by TA3 performers. These algorithms today are often written in a higher level language such as C, JAVA or Python. The code then is compiled using custom tool chains which target them to the type of processor being used. HIVE is expected to need a similar tool chain which allows users to target those same algorithms to the hardware being developed by TA1 performers. This tool chain is intended to be packaged as a software development kit (SDK) and will be critical to ensure rapid adoption of the new graph hardware. A successful tool chain should allow programmers to port their algorithms and experience an improvement both in power and in performance without a detailed knowledge of the underlying hardware in their system. The initial beta release of the tools must be delivered to TA1 and 3 at the end of the phase as seen in figure #3.

Phase 3: Demonstration (18 month option period)

In the demonstration phase of TA2, it is intended that performers provide and make the adjustments required to support necessary changes based on testing done in the prototype phase and identified during initial chip testing. The goal is to mature the tools to a point where it could be used as an open source software development kit (SDK) for graph developers. The initial beta release of the tools must be delivered to TA1 and 3 at the end of the phase as seen in figure #3.

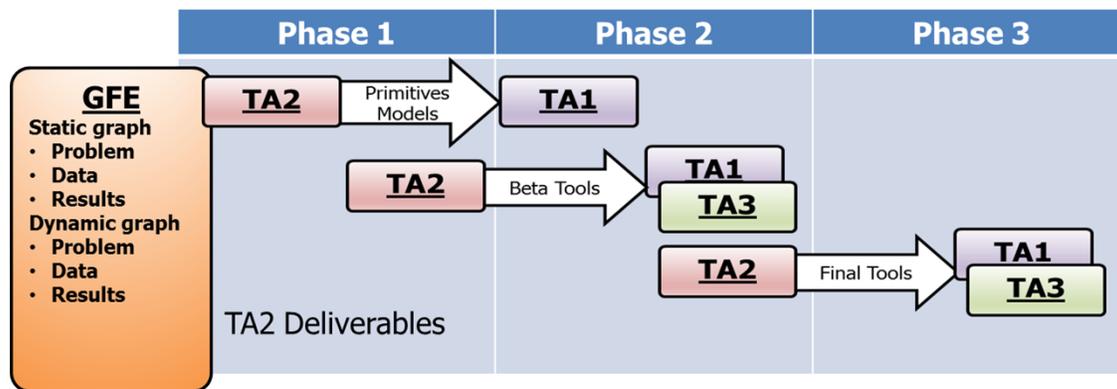


Figure #3 TA2 schedule of deliverables to TA1/3

3. Technical Area Three (TA3): System Evaluator

TA3 aims to identify and develop static and streaming graph analytics to solve five types of problem areas: anomaly detection, domain specific search, dependency mapping, N-x contingency analysis, and causal modeling of events. Examples of these types of problems can be found at <https://www.ll.mit.edu/publications/journal/journalarchives20-1.html>. The goal of

TA3 is to choose typical DoD problems which represent one of the above problem areas and apply TA1 and TA2 technologies to them. The goal is to see a 1000x improvement in power and performance on the HIVE chip compared to a GPU. TA3 performers should also focus on identifying new uses for graph analytics that have been abandoned in previous research due to processing, power, or size constraints.

Phase 1: Architecture (12 month base period)

In the architectural phase of TA3, performers are strongly encouraged to evaluate current DoD problems which require graph analytics and identify future potential use cases in order to:

- a) Develop realistic usage scenarios which could benefit from the graph processors. **Note: These scenarios may be classified up to the TS/SCI SAP level.**
- b) Develop unclassified algorithms, datasets, and test vectors required by TA1 and TA2 performers to design new software and hardware tools.
- c) Identify any DoD specific needs which may impact the technologies being developed by TA1 and TA2 performers.

TA3 performers will use their experience with existing DoD graph analytic systems as a basis for their efforts. Since this is the only TA which may leverage classified information (during DoD usage scenario development), performers planning to do so will need to be equipped appropriately to handle and process such information, as well as have experience in DoD systems that perform graph analytics. The goal of Phase 1 is for TA3 performers to augment the government furnished data provided to TA1 and TA2 performers with additional information, based on both existing and potential future DoD systems and needs for graph analytics. This delivery is shown in Figure #4.

Phase 2: Prototype (24 month option period)

In the prototype phase of the TA3, performers should apply the algorithms, datasets, and test vectors developed in phase 1 and baseline their performance on existing graphics processing unit (GPU) systems. TA3 performers should then use the tools provided by TA1 and TA2 performers on the same government graph problems that have just been benchmarked to drive feedback on the performance of the new approaches. These results will be presented to TA1/2 as seen in Figure #4.

Phase 3: Demonstration (18 month option period)

In the demonstration phase of TA3, it is intended that performers make any beneficial adjustments to their algorithms to accommodate the results of the prototype phase. They should also design and implement their algorithms to fully utilize a 16 node cluster for an appropriate set of DoD mission applications. Performers should expect to implement their algorithms on the tools provided by TA2 performers and execute them on a compute cluster developed from hardware provided by TA1 performers. It is anticipated that performers document a wide variety of characteristics of this demonstration, including the improvement realized by the tool/hardware, performance and scalability of the system, ease of application development, and impact to both current and future DoD analytic needs. The results of this work will be presented to both TA1 and TA2 as seen in Figure #4.

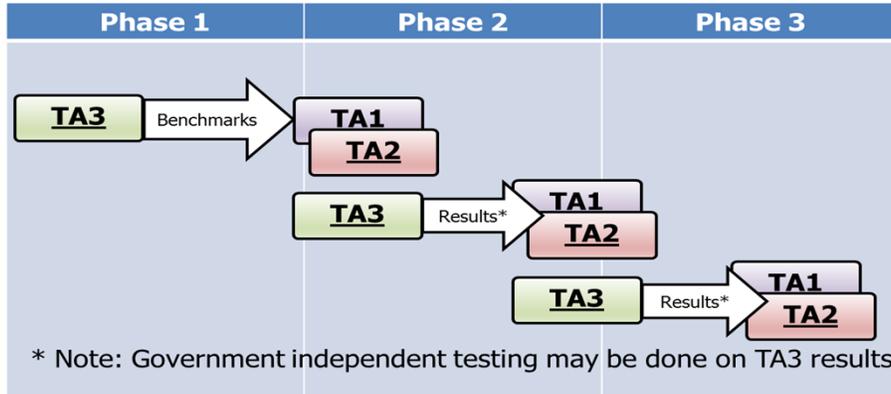


Figure #4: TA3 schedule of deliverable to TA1/2

C. Core Technologies and Deliverables

Technical Area One (TA1): Graph Analytics Processor

Core Technologies

Graph Analytics Processors are a new class of general purpose processors which accelerate graph processing. They are designed to accelerate graph primitives identified by the government and TA2/TA3. They are designed to minimize processor idle time by efficiently moving data from external memory and from adjacent processing chips. This involves the creation of a new memory controller and scalable hierarchy which ensures data is moved from external memory into the new accelerators at the same rate as the processing occurs. This will likely require performance exceeding 1 TBps. It also calls for a new inter processor interconnect that allows adjacent processors to move data to and from each other at rates likely to exceed 1 TBps to prevent the introduction of data processing bottlenecks.

TA1 is focused on the development and fabrication of a highly scalable graph processor architecture which has the following sub block features:

- a) An accelerator architecture and processor pipeline which supports the processing of identified graph primitives in a native matrix format.
- b) A chip (or possibly multichip) architecture that support the easy movement of data from memory or IOs to the accelerators based on an identified data flow model. Emphasis should be on redefining cache based architectures so that they address both sparse and dense data sets. Integration of the processor and memory architecture may be necessary.
- c) An external memory controller which is designed to ensure efficient use of the identified data mapping tools. The controller should be able to efficiently handle random as well as sequential memory accesses. Every effort should be made to minimize the size of the data access to avoid the need to pad memory. The use of advanced memory technology may be necessary.

Performance Objectives

Metric	Phase 1: Architecture	Phase 2: Prototype	Phase 3:
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			Demonstration
Accelerator architecture and pipeline	Show functionality of accelerators through simulation	Demonstrate functionality of accelerators on a real data set running a real algorithm	Enable 1000X improvement in performance as compared to equivalent operation on a GPU and scale to less than 20W
Enable efficient data movement between processors and memory and inter processor data movement for scaling	Enable 1TB/s bandwidth between the processor and external memory and the inter processor communication at 1TB/s in simulation	Show that the system is no longer IO or memory bound and that there is sufficient bandwidth and efficiency to run provide graph algorithms	Demonstrate efficient performance (balanced performance) across 16 processor nodes without processor bandwidth stalls
External Memory controller	Develop a memory controller that efficiently takes advantage of the data maps developed by TA2	Demonstrate that the memory access efficiency of random access transactions is comparable to the memory access efficiency of sequential memory access (within 75%)	Show greater than 90% memory efficiency on both random access and sequential access memory usage patterns at small data access sizes

Proposals should address the following critical questions:

1) How will you create a chip architecture which efficiently takes advantage of graph primitives?

The performer should understand the logic required to implement the graph primitives. This understanding should include sizing memory buffers to support multi-dimensional matrix representations of data natively without encoding the same data in multiple data formats. New processing pipelines may need to be created to efficiently execute the new primitives and data formats.

2) How would you use the data flow model to ensure load balancing of large scale systems?

Understanding how data moves from memory, processors, and between processing nodes is essential to creating a computer architecture that avoids processor stalls common in today's systems. The ability to map problems on to more than one processor is critical in today's parallel processing schemes which typically struggle with cluster sizes above 16. Performers should propose (with supporting evidence) an architecture and data flow model for which memory latency, bandwidth, and capacity scale well with problem size.

3) How will you design a memory controller to take advantage of the data maps?

The key to efficient processing of large scale graph analytics is to ensure the locality of information. The less you have to move the data, the more efficient the computation from both a power and performance perspective. The memory controller needs to exploit locality regardless of whether the dataset is sparse or dense.

Milestones and Deliverables

- Deliverable #1: Base Period: 12 months (Architecture)
 - GFE: Initial set of graph benchmarks and sparse graph model
 - Data will be delivered as a mission/application statement with supporting data/solution (similar to VAST challenge)
 - Likely include: FIREHOSE benchmark, PageRank Pipeline benchmark, GraphBLAS standard operations
 - Output:
 - HW simulator and simulation results on graph benchmarks/primitives (for TA2 to use for toolkit development)
 - Simulation/evidence of performance under weak and strong scaling
 - Block diagram and schematic of graph processor
- Deliverable #2: Option Period 1: 24 months (Prototype)
 - Implement and refine chip architecture (based on TA2 feedback from simulator) to address current memory bottlenecks for sparse data acceleration of graph primitives
 - Update dataflow model / architecture scalable to a 16 nodes with anticipated performance numbers
 - Develop system level scaling model including electrical, mechanical, and thermal needs
 - Output:
 - Updated block diagram and schematic of graph processor
 - PCB/FPGA prototype of chip and performance results on graph benchmarks /primitives (for TA2 to use for toolkit development)
 - GDS2 file in preparation for fabrication
- Deliverable #3: Option Period 2: 18 Months (Demonstration)
 - Bring up and test chip fab
 - Identify any bugs that can be worked around with software
 - Identify any bugs which require a chip re-spin
 - Build and test system at scale (16 nodes)
 - Output:
 - Deliver test board with silicon and scale system (16 nodes) to TA3 for testing of toolkits

Technical Area Two (TA2): Graph Analytics Toolkits

Core Technologies

Graph Analytics Toolkits are lower level middleware that seamlessly translate higher level application languages and frameworks such as C, Python, TensorFlow, Caffe, etc. into low level primitives that can be run by the hardware. These software tools use to be called compilers which took higher level languages and translated it into binary executables. The toolkits often include a scheduler and memory optimizer which moved the code so that it would be more cache and pipeline friendly for the hardware. Now these tools form part of the software development kits which are crucial to the success of any hardware. The purpose of this task is to develop a tool chain and middleware which abstracts out the specifics of the hardware implementation but still allows users to take advantage of low level primitives for the extra performance. Successful performers are anticipated to have a strong knowledge of both graph analytics algorithms and software and a strong knowledge of how hardware works.

TA2 focuses on defining and producing the following items:

- a) create a prioritized list of graph primitives suitable for acceleration; highest priority is given to the primitive that would improve baseline performance the most if accelerated
- b) a data flow model which evaluates the required bandwidths, data sizes, and access patterns which optimize the processing of the graph primitives
- c) identify data maps which maps sparse graphs into available memory architectures and allow for easy retrieval of the data

Performance Objectives

Metric	Phase 1: Architecture	Phase 2: Prototype	Phase 3: Demonstration
Graph Primitives	Identify a set of graph primitives used in sparse and dense graph algorithms. Primitives apply to dynamic and static graphs	Be able to translate current graph algorithms to enable functionally equivalent performance on the new hardware	Be able to enable 100X improvement in performance with no optimization effort and 1000X improvement with optimization as compared with an equivalent GPU
Data Flow Model	Model the data flow between various set of primitives based on a given set of graph algorithms	Optimizer/Scheduler capable of mapping the processing and showing load balancing between processor nodes and memory.	Optimizer/Scheduler capable of load balancing across a cluster of at least 16 processing nodes
Data Mapping	Model the data hierarchy required by common graph algorithms and map	Be able to show efficient mapping to prevent processor stalls based on TA1's	Show that the software efficiently utilizes hardware to minimize the time to perform

	into an optimal memory hierarchy on and off chip	memory hierarchy	memory transfers (goal: less than 50% of execution time)
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Proposals should address the following critical questions:

1) How will you determine the right set of graph primitives to accelerate?

Performers will be provided with a set of algorithms to decompose. A good proposal should detail the process for making the determination of what is and is not a good candidate for acceleration.

2) How will you develop a data flow model for graph analytics?

Understanding how and why data is moved in a system is crucial in creating a processing architecture which is load balanced and processing efficient. It's important to develop a methodology for determining how and when to pass data from one processing element to another and how often the system needs to access local memory.

3) How will you map data onto memory?

In order to minimize data movement, it's important to identify how data is to be stored into memory to ensure that the processing units are fully utilized and that the time spent moving data is less than the time it takes to actually perform the calculation. The system should be processor and not memory bound.

Deliverables

- Deliverable #1: Base Period:12 months (Architecture)
 - GFE: Initial set of graph benchmarks and sparse graph model
 - Data will be delivered as a mission/application statement with supporting data/solution (similar to VAST challenge)
 - Likely include: FIREHOSE benchmark, PageRank Pipeline benchmark, GraphBLAS standard operations
 - Output:
 - Recommended tool chain / programming model
 - Performance results of recommended tool chain / programming model and comparison to alternative approaches (implemented on appropriate GPU/CPU/specialized systems)
 - Prioritized list of primitives
- Deliverable #2: Option Period 1: 24 months (Prototype)
 - Interface programming model / tool chain with TA1 Simulators/Emulators
 - Compiler optimized for hardware simulation/emulation including new primitives
 - Implement programming model/tool chain to characterize the performance of benchmarking analytics on Simulators/Emulators

- Output
 - Tool chain / programming model performance results and comparisons for TA1 provided simulation/emulation HW models.
 - Programming tool chain including compiler and optimizer for each set of hardware delivered by TA1 performers
 - Prioritized list of primitives
 - Analysis of performance issues and bottlenecks
- Deliverable #3: Option Period 2: 18 Months (Demonstration)
 - Deliver graph analytic tool set for use with HIVE chip
 - Make adjustments based on actual chip fab
 - Fix bugs and do additional tuning based on results of Phase 2
 - Implement programming model/tool chain to characterize the performance of benchmarking analytics on single node and 16 node system
 - Performance results

Technical Area Three (TA3): System Evaluator

Core Technologies

The role of the evaluator on the HIVE program is to understand how graph analytics is used today in DoD systems and how it could be applied to other DoD problems if the processing was available to meet performance needs. The goal is to map existing DoD problems into five basic categories: anomaly detection, domain specific search, dependency mapping, N-X contingency analysis, and causal modeling of events. Performers are expected to have knowledge of DoD systems based on prior experience and be able to discuss them at the TS/SCI SAP level. Currently these problems solve static graph problems. TA3 performers are also expected to identify dynamic graph problems (and exceptionally large static problems) in each of the categories which are not being solved today by graph analytics due to limitations in processing.

TA3 is focused on the development of test use cases which are graph analytics based and have the following features

- a) Realistic usage scenarios which could benefit from the graph processors. These scenarios may be classified up to TS/SCI SAP
- b) Contain unclassified algorithms, datasets, and test vectors needed by TA1 and TA2 to design new software and hardware tools
- c) Cover any DoD specific needs which may impact the technologies being developed by TA1 and TA2

Proposals should address the following critical questions:

- 1) How is graph analytics being used by the DoD today?

Need to identify relevant use cases for graph analytics. Understand the underlying problem being solved by graph analytics and the current limitations in its usage today that are technology

related. Experience in developing DoD analytics systems and the ability to work with and store classified information is a requirement to perform on this task

2) How can DoD problems be translated into unclassified use cases which can be used by technology companies?

Performers should address how to generate information about the use case which the other TA's can use to develop the new technologies. This new data should still be representative of the actual DoD problem in order to ensure usability by the DoD in the future.

3) Based on experience gained from building actual DoD systems, are there additional system level considerations which must be taken into account?

Size, weight and power are always critical to every DoD system. The military use of technologies usually goes beyond what most commercial companies encounter. It is critical that size, weight, and power constraints are understood especially by the TA1 performers.

Milestones and Deliverables

- Deliverable #1: 12 months (Architecture)
 - GFE: Initial set of graph benchmarks and sparse graph model
 - Data will be delivered as a mission/application statement with supporting data/solution (similar to VAST challenge)
 - Likely include: FIREHOSE benchmark, PageRank Pipeline benchmark, GraphBLAS standard operations
 - Output:
 - Benchmark and datasets which characterize DoD current and future graph problems
- Deliverable #2: 24 months (Prototype)
 - Benchmark both new and existing DoD applications identified in phase 1 on GPU's/CPU's.
 - Baseline performance for comparison to SW/HW under development by TA1 and TA2.
 - Identify performance issues and bottlenecks
 - Identify graph primitives which would benefit from HW acceleration
 - Apply the HW developed by TA1 and the toolkits developed by TA2 to problems identified in Phase 1
 - Provide feedback to TA1 and TA2 about improvements in power and performance required to meet DoD needs
 - Output
 - List of issues and bugs related to the application of TA1 and TA2's efforts
 - Suggested fixes and system level needs to TA1 and TA2
 - Physical design specs, performance, and system scale necessary for DoD applications
- Deliverable #3: 18 Months (Demonstration)
 - Apply DoD benchmark set to final chip and software

- Test scaling of on a 16 node cluster on relevant DoD apps.
- Output:
 - Report additional work required for transition of the chip and software
 - Report performance / mission impact of graph processor and 16 node cluster on relevant DoD applications

In addition to the above, all performers are desired to provide documentation concerning:

- Quarterly Technical Reports and Reviews – Technical reports in a format suitable for briefing, along with any necessary supplementary materials. Reports should be delivered in a timely manner, ideally two weeks after the TA3 kick-off meeting and four working days prior to each quarterly program review and PI meeting. Program reviews amongst all performers are expected to be held as part of planned PI meetings.
- Monthly Financial Reports – The financial report should describe resources expended, resources available, any deviation from planned expenditures and any potential issues requiring the attention of the Government team. This report should be provided on a monthly basis within 10 days of the end of each month.
- Technical and Management Work Plan – This document should capture the project schedule including milestones and updated as necessary.

II. Award Information

Multiple awards are anticipated. The amount of resources made available under this BAA will depend on the quality of the proposals received and the availability of funds.

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 proposers. The Government also reserves the right to conduct discussions if it is later determined to be necessary. If warranted, portions of resulting awards may be segregated into pre-priced options. Additionally, DARPA reserves the right to accept proposals in their entirety or to select only portions of proposals for award. In the event that DARPA desires to award only portions of a proposal, negotiations may be opened with that proposer. The Government reserves the right to fund proposals in phases with options for continued work at the end of one or more of the phases.

Awards under this BAA will be made to proposers on the basis of the evaluation criteria listed below (see section labeled “Application Review Information,” Sec. V.), and program balance to provide overall value to the Government. The Government reserves the right to request any additional, necessary documentation once it makes the award instrument determination. Such additional information may include but is not limited to Representations and Certifications. The Government reserves the right to remove proposers from award consideration should the parties fail to reach agreement on award terms, conditions and cost/price within a reasonable time or the proposer fails to timely provide requested additional information. Proposals identified for negotiation may result in a procurement contract or other transaction, depending upon the nature of the work proposed, the required degree of interaction between parties, whether or not the research is classified as Fundamental Research, and other factors.

In all cases, the Government contracting officer shall have sole discretion to select award instrument type and to negotiate all instrument terms and conditions with selectees. Proposers are advised that regardless of the instrument type proposed, DARPA personnel, in consultation with the Government contracting officer, may select other award instruments, as they deem appropriate. DARPA will apply publication or other restrictions, as necessary, if it determines that the research resulting from the proposed effort will present a high likelihood of disclosing performance characteristics of military systems or manufacturing technologies that are unique and critical to defense. Any award resulting from such a determination will include a requirement for DARPA permission before publishing any information or results on the program. For more information on publication restrictions, see the section below on Fundamental Research.

Fundamental Research

It is DoD policy that the publication of products of fundamental research will remain unrestricted to the maximum extent possible. National Security Decision Directive (NSDD) 189 established the national policy for controlling the flow of scientific, technical, and engineering information produced in federally funded fundamental research at colleges, universities, and laboratories. The Directive defines fundamental research as follows:

'Fundamental research' means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons.

As of the date of publication of this BAA, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research. The Government does not anticipate applying publication restrictions of any kind to individual awards for fundamental research that may result from this BAA. Notwithstanding this statement of expectation, the Government is not prohibited from considering and selecting research proposals that, while perhaps not qualifying as fundamental research under the foregoing definition, still meet the BAA criteria for submissions. If proposals are selected for award that offer other than a fundamental research solution, the Government will either work with the proposer to modify the proposed statement of work to bring the research back into line with fundamental research or else the proposer will agree to restrictions in order to receive an award.

Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to select award instrument type and to negotiate all instrument terms and conditions with selectees. Appropriate clauses will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate.

For certain research projects, it may be possible that although the research being performed by the prime contractor is restricted research, a subawardee may be conducting fundamental

research. In those cases, it is the prime contractor's responsibility to explain in its proposal why its subawardee's effort is fundamental research.

The following statement or similar provision will be incorporated into any resultant non-fundamental research procurement contract or other transaction:

There shall be no dissemination or publication, except within and between the contractor and any subawardees, of information developed under this contract or contained in the reports to be furnished pursuant to this contract without prior written approval of DARPA's Public Release Center (DARPA/PRC). All technical reports will be given proper review by appropriate authority to determine which Distribution Statement is to be applied prior to the initial distribution of these reports by the contractor. With regard to subawardee proposals for Fundamental Research, papers resulting from unclassified fundamental research are exempt from prepublication controls and this review requirement, pursuant to DoD Instruction 5230.27 dated October 6, 1987.

When submitting material for written approval for open publication, the contractor/awardee must submit a request for public release to the DARPA/PRC and include the following information: (1) Document Information: document title, document author, short plain-language description of technology discussed in the material (approx. 30 words), number of pages (or minutes of video) and document type (e.g., briefing, report, abstract, article, or paper); (2) Event Information: event type (conference, principal investigator meeting, article or paper), event date, desired date for DARPA's approval; (3) DARPA Sponsor: DARPA Program Manager, DARPA office, and contract number; and (4) Contractor/Awardee's Information: POC name, email and phone. Allow four weeks for processing; due dates under four weeks require a justification. Unusual electronic file formats may require additional processing time. Requests may be sent either via email to public_release_center@darpa.mil or by mail at 675 North Randolph Street, Arlington VA 22203-2114, telephone (571) 218-4235. Refer to the following for link for information about DARPA's public release process: <http://www.darpa.mil/work-with-us/contract-management/public-release>."

III. Eligibility Information

All responsible sources capable of satisfying the Government's needs may submit a proposal that shall be considered by DARPA.

A. Eligible Applicants

Federally Funded Research and Development Centers (FFRDCs) and Government entities (e.g., Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations and cannot propose to this BAA in any capacity unless they meet the following conditions: (1) FFRDCs must clearly demonstrate that the proposed work is not otherwise available from the private sector; and (2) FFRDCs must provide a letter on official letterhead from their sponsoring organization citing the specific authority establishing their eligibility to propose to Government solicitations and compete with industry, and their

compliance with the associated FFRDC sponsor agreement's terms and conditions. This information is required for FFRDCs proposing to be prime contractors or subawardees. Government entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority and contractual authority, if relevant, establishing their ability to propose to Government solicitations. At the present time, DARPA does not consider 15 U.S.C. § 3710a to be sufficient legal authority to show eligibility. While 10 U.S.C. § 2539b may be the appropriate statutory starting point for some entities, specific supporting regulatory guidance, together with evidence of agency approval, will still be required to fully establish eligibility. DARPA will consider FFRDC and Government entity eligibility submissions on a case-by-case basis; however, the burden to prove eligibility for all team members rests solely with the proposer.

Non-U.S. organizations and/or individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.

B. Procurement Integrity, Standards of Conduct, Ethical Considerations, and Organizational Conflicts of Interest

Current federal employees are prohibited from participating in particular matters involving conflicting financial, employment, and representational interests (18 U.S.C. §§ 203, 205, and 208). Once the proposals have been received, and prior to the start of proposal evaluations, the Government will assess potential conflicts of interest and will promptly notify the proposer if any appear to exist. The Government assessment does NOT affect, offset, or mitigate the proposer's responsibility to give full notice and planned mitigation for all potential organizational conflicts, as discussed below.

Without prior approval or a waiver from the DARPA Director, in accordance with FAR 9.503, a contractor cannot simultaneously provide scientific, engineering, technical assistance (SETA) or similar support and also be a technical performer. As part of the proposal submission, all members of the proposed team (prime proposers, proposed subawardees, and consultants) must affirm whether they (their organizations and individual team members) are providing SETA or similar support to any DARPA technical office(s) through an active contract or subcontract. All affirmations must state which office(s) the proposer, subawardees, consultant, or individual supports and identify the prime contract number(s). All facts relevant to the existence or potential existence of organizational conflicts of interest (FAR 9.5) must be disclosed. The disclosure must include a description of the action the proposer has taken or proposes to take to avoid, neutralize, or mitigate such conflict. If in the sole opinion of the Government after full consideration of the circumstances, a proposal fails to fully disclose potential conflicts of interest and/or any identified conflict situation cannot be effectively mitigated, the proposal will be rejected without technical evaluation and withdrawn from further consideration for award.

If a prospective proposer believes a conflict of interest exists or may exist (whether organizational or otherwise) or has questions on what constitutes a conflict of interest, the proposer should send his/her contact information and a summary of the potential conflict via

email to the BAA email address before time and effort are expended in preparing a proposal and mitigation plan.

C. Cost Sharing/Matching

Cost sharing is not required; however, it will be carefully considered where there is an applicable statutory condition relating to the selected funding instrument (e.g., for any Other Transactions under the authority of 10 U.S.C. § 2371). Cost sharing is encouraged where there is a reasonable probability of a potential commercial application related to the proposed research and development effort.

D. Other Eligibility Criteria

1. Ability to support Classified Development

Technical Area 3 performers will be required to support access to DoD use cases which may be classified up to the TS/SCI SAP level.

2. Collaborative Efforts

Collaborative efforts/teaming are encouraged.

E. Associate Contractor Agreement (ACA) Clause

This same or similar clause will be included in all awards against DARPA-BAA-16-52:

- (a) It is recognized that success of the HIVE research effort depends in part upon the open exchange of information between the various Associate Contractors involved in the effort. This clause is intended to insure that there will be appropriate coordination and integration of work by the Associate Contractors to achieve complete compatibility and to prevent unnecessary duplication of effort. By executing this contract, the Contractor assumes the responsibilities of an Associate Contractor. For the purpose of this clause, the term Contractor includes subsidiaries, affiliates, and organizations under the control of the contractor (e.g. subcontractors).
- (b) Work under this contract may involve access to proprietary or confidential data from an Associate Contractor. To the extent that such data is received by the Contractor from any Associate Contractor for the performance of this contract, the Contractor hereby agrees that any proprietary information received shall remain the property of the Associate Contractor and shall be used solely for the purpose of the HIVE research effort. Only that information which is received from another contractor in writing and which is clearly identified as proprietary or confidential shall be protected in accordance with this provision. The obligation to retain such information in confidence will be satisfied if the Contractor receiving such information utilizes the same controls as it employs to avoid disclosure, publication, or dissemination of its own proprietary information. The receiving Contractor agrees to hold such information in confidence as provided herein so long as such information is of a proprietary/confidential or limited rights nature.

- (c) The Contractor hereby agrees to closely cooperate as an Associate Contractor with the other Associate Contractors on this research effort. This involves as a minimum:
 - (1) Maintenance of a close liaison and working relationship;
 - (2) Maintenance of a free and open information network with all Government-identified Associate Contractors;
 - (3) Delineation of detailed interface responsibilities;
 - (4) Entering into a written agreement with the other Associate Contractors setting forth the substance and procedures relating to the foregoing, and promptly providing the Agreements Officer/Procuring Contracting Officer with a copy of same; and,
 - (5) Receipt of proprietary information from the Associate Contractor and transmittal of Contractor proprietary information to the Associate Contractors subject to any applicable proprietary information exchange agreements between associate contractors when, in either case, those actions are necessary for the performance of either.
- (d) In the event that the Contractor and the Associate Contractor are unable to agree upon any such interface matter of substance, or if the technical data identified is not provided as scheduled, the Contractor shall promptly notify the DARPA HIVE Program Manager. The Government will determine the appropriate corrective action and will issue guidance to the affected Contractor.
- (e) The Contractor agrees to insert in all subcontracts hereunder which require access to proprietary information belonging to the Associate Contractor, a provision which shall conform substantially to the language of this clause, including this paragraph (e).
- (f) Associate Contractors for this HIVE research effort include:

Contractor

Area

Note: It is intended that ACA's be established, after selections and prior to contract award, between:

1. Each TA1 and TA2 performer.
2. Each TA1 and TA3 performer.
3. Each TA2 and TA3 performer.

IV. Application and Submission Information

A. Address to Request Application Package

This solicitation contains all information required to submit a proposal. No additional forms, kits, or other materials are needed. This notice constitutes the total BAA solicitation. No additional information is available, except as provided at FBO.gov, nor will a formal Request for Proposal (RFP) or additional solicitation regarding this announcement be issued. Requests for the same will be disregarded.

B. Content and Form of Application Submission

DARPA policy is to treat all submissions as source selection information (see FAR 2.101 and 3.104), and to disclose their contents only for the purpose of evaluation. Restrictive notices notwithstanding, during the evaluation process, submissions may be handled by support contractors for administrative purposes and/or to assist with technical evaluation. All DARPA support contractors performing this role are expressly prohibited from performing DARPA-sponsored technical research and are bound by appropriate nondisclosure agreements.

Submissions will not be returned. The original of each submission received will be retained at DARPA and all other non-required copies destroyed. A certification of destruction may be requested, provided the formal request is received at this office within 5 days after notification that a proposal was not selected.

1. Proprietary Information

Proposers are responsible for clearly identifying proprietary information. Submissions containing proprietary information must have the cover page and each page containing such information clearly marked with a label such as “Proprietary” or “Company Proprietary.” Note, “Confidential” is a classification marking used to control the dissemination of U.S. Government National Security Information as dictated in Executive Order 13526 and should not be used to identify proprietary business information.

2. Security Information

DARPA anticipates that submissions received under this BAA will be unclassified. However, should a proposer wish to submit classified information, submissions shall be transmitted in accordance with the following guidance. Additional information on the subjects discussed in this section may be found at <http://www.dss.mil/>.

Security classification guidance and direction via a Security Classification Guide (SCG) and/or DD Form 254, “DoD Contract Security Classification Specification,” will not be provided at this time, since DARPA expects that program goals may be met by proposers intending to perform fundamental research. If a determination is made that the award instrument may result in access to classified information, a SCG and/or DD Form 254 will be issued by DARPA and attached as part of the award.

If a submission contains Classified National Security Information as defined by Executive Order 13526, the information must be appropriately and conspicuously marked with the proposed classification level and declassification date. Similarly, when the classification of a submission is in question, the submission must be appropriately and conspicuously marked with the proposed classification level and declassification date. Submissions requiring DARPA to make a final classification determination shall be marked as follows:

“CLASSIFICATION DETERMINATION PENDING. Protect as though classified
 _____ (insert the recommended classification level, e.g., Top Secret,
 Secret or Confidential).”

NOTE: Classified submissions must indicate the classification level of not only the submitted materials, but also the classification level of the anticipated award.

Proposers submitting classified information must have, or be able to obtain prior to contract award, cognizant security agency approved facilities, information systems, and appropriately cleared/eligible personnel to perform at the classification level proposed. All proposer personnel performing Information Assurance (IA)/Cybersecurity related duties on classified Information Systems shall meet the requirements set forth in DoD Manual 8570.01-M (Information Assurance Workforce Improvement Program).

Proposers choosing to submit classified information from other collateral classified sources (i.e., sources other than DARPA) must ensure (1) they have permission from an authorized individual at the cognizant Government agency (e.g., Contracting Officer, Program Manager); (2) the proposal is marked in accordance with the source Security Classification Guide (SCG) from which the material is derived; and (3) the source SCG is submitted along with the proposal.

Confidential and Secret Information

Use transmission, classification, handling, and marking guidance provided by previously issued SCGs, the DoD Information Security Manual (DoDM 5200.01, Volumes 1 - 4), and the National Industrial Security Program Operating Manual, including the Supplement Revision 1, (DoD 5220.22-M and DoD 5200.22-M Sup. 1) when submitting Confidential and/or Secret classified information.

Confidential and Secret classified information may be submitted via ONE of the two following methods:

- Hand-carried by an appropriately cleared and authorized courier to the DARPA CDR. Prior to traveling, the courier shall contact the DARPA Classified Document Registry (CDR) at 703-526-4052 to coordinate arrival and delivery.

OR

- Mailed via U.S. Postal Service (USPS) Registered Mail or USPS Express Mail. All classified information will be enclosed in opaque inner and outer covers and double-wrapped. The inner envelope shall be sealed and plainly marked with the assigned classification and addresses of both sender and addressee.

The inner envelope shall be addressed to:

Defense Advanced Research Projects Agency
ATTN: Program Security Officer, MTO
Reference: DARPA-BAA-16-52
675 North Randolph Street
Arlington, VA 22203-2114

The outer envelope shall be sealed with no identification as to the classification of its contents and addressed to:

Defense Advanced Research Projects Agency
Security & Intelligence Directorate, Attn: CDR
675 North Randolph Street
Arlington, VA 22203-2114

Top Secret Information

Use classification, handling, and marking guidance provided by previously issued SCGs, the DoD Information Security Manual (DoDM 5200.01, Volumes 1 - 4), and the National Industrial Security Program Operating Manual, including the Supplement Revision 1, (DoD 5220.22-M and DoD 5200.22-M Sup. 1). Top Secret information must be hand-carried by an appropriately cleared and authorized courier to the DARPA CDR. Prior to traveling, the courier shall contact the DARPA CDR at 703-526-4052 to coordinate arrival and delivery.

Sensitive Compartmented Information (SCI)

SCI must be marked, managed and transmitted in accordance with DoDM 5105.21 Volumes 1 - 3. Questions regarding the transmission of SCI may be sent to the DARPA Technical Office PSO via the BAA mailbox or by contacting the DARPA Special Security Officer (SSO) at 703-812-1970.

Successful proposers may be sponsored by DARPA for access to SCI. Sponsorship must be aligned to an existing DD Form 254 where SCI has been authorized. Questions regarding SCI sponsorship should be directed to the DARPA Personnel Security Office at 703-526-4543.

Special Access Program (SAP) Information

SAP information must be marked in accordance with DoDM 5205.07 Volume 4 and transmitted by specifically approved methods which will be provided by the Technical Office PSO or their staff.

Proposers choosing to submit SAP information from an agency other than DARPA are required to provide the DARPA Technical Office Program Security Officer (PSO) written permission from the source material's cognizant Special Access Program Control Officer (SAPCO) or designated representative. For clarification regarding this process, contact the DARPA Technical Office PSO via the BAA mailbox or the DARPA SAPCO at 703-526-4102.

Additional SAP security requirements regarding facility accreditations, information security, personnel security, physical security, operations security, test security, classified transportation plans, and program protection planning may be specified in the DD Form 254.

NOTE: prior to drafting the submission, if use of SAP Information Systems is to be proposed, proposers must first obtain an Authorization-to-Operate from the DARPA Technical Office PSO (or other applicable DARPA Authorization Official) using the Risk Management Framework (RMF) process outlined in the Joint Special Access Program (SAP) Implementation Guide (JSIG), Revision 3, dated October 9, 2013 (or successor document).

3. Abstract Format

Abstracts should follow the format described below in this section. The cover sheet should be clearly marked “ABSTRACT” and the total length of Section II should not exceed 5 pages. Separate abstracts should be submitted for each TA addressed, meaning the abstract should cover only one technical area, either TA1, TA2, or TA3. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller font may be used for figures, tables and charts. The page limitation for abstracts includes all figures, tables, and charts. No formal transmittal letter is required. All abstracts must be written in English.

DARPA will respond to abstracts with a statement as to whether DARPA is interested in the idea. If DARPA does not recommend the proposer submit a full proposal, DARPA will provide feedback to the proposer regarding the rationale for this decision. Regardless of DARPA’s response to an abstract, proposers may submit a full proposal. DARPA will review all full proposals submitted using the published evaluation criteria and without regard to any comments resulting from the review of an abstract.

Section I. Administrative

A. Cover sheet to include:

- (1) BAA number (DARPA-BAA-16-52);
- (2) Technical area;
- (3) Lead Organization submitting proposal abstract;
- (4) Type of organization, selected among the following categories: “LARGE ORGANIZATION,” “SMALL DISADVANTAGED ORGANIZATION,” “OTHER SMALL ORGANIZATION,” “HBCU,” “MI,” “OTHER EDUCATIONAL,” OR “OTHER NONPROFIT;”
- (5) Proposer’s reference number (if any);
- (6) Other team members (if applicable) and type of organization for each;
- (7) Proposal title;
- (8) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
- (9) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
- (10) Total funds requested from DARPA, and the amount of cost share (if any); AND
- (11) Date proposal abstract was submitted.

(Note: An official transmittal letter is not required when submitting a Proposal Abstract.)

Section II. Abstract Details

- A. Summary of innovative claims for the proposed research. This section is the centerpiece of the abstract and should succinctly describe the uniqueness and benefits of the proposed approach relative to the current state-of-art alternate approaches.
- B. Deliverables associated with the proposed research and the plans and capability to accomplish technology transition and commercialization. Include in this section all proprietary claims to the results, prototypes, intellectual property, or systems supporting and/or necessary for the use of the research, results, and/or prototype. If there are no proprietary claims, this should be stated. For forms to be completed regarding intellectual property, see Section VIII. There will be no page limit for the listed forms.
- C. Technical rationale, technical approach, and constructive plan for accomplishment of technical goals in support of innovative claims and deliverable production.
- D. General discussion of other research in this area.
- E. A clearly defined organization chart for the program team which includes, as applicable: (1) the programmatic relationship of team member; (2) the unique capabilities of team members; (3) the task of responsibilities of team members; (4) the teaming strategy among the team members; and (5) the key personnel along with the amount of effort to be expended by each person during each year.

4. Full Proposal Format

All full proposals must be in the format given below. Proposals shall consist of two volumes: Volume I – Technical and Management Proposal, and Volume II – Cost Proposal. The submission of other supporting materials along with these volumes is strongly discouraged and will not be considered for review. All pages shall be printed on 8-1/2 by 11 inch paper with type not smaller than 12 point. Smaller font may be used for figures, tables and charts. Any proposal which covers more than one technical area must be written in such a way as to ensure there is no dependency between the different technical areas. This allows for segmentation of the proposal if needed.

Section II of Volume I, Technical and Management Proposal, shall not exceed 15 pages for proposals addressing only one TA. If the proposal addresses more than one of the technical areas, Section II of Volume 1, Technical and Management Proposal, shall not exceed 30 pages. All full proposals must be written in English. The page limitation for full proposals includes all figures, tables, and charts.

A summary slide of the proposed effort, in PowerPoint format, should be submitted with the proposal. A template slide is provided as Attachment 2 to the BAA. Submit this PowerPoint file in addition to Volumes I and II of your full proposal. This summary slide does not count towards the total page count.

a. Volume I, Technical and Management Proposal

Section I. Administrative

A. Cover sheet to include:

- (1) BAA number (DARPA-BAA-16-52);
- (2) Technical area(s);
- (3) Lead Organization submitting proposal;
- (4) Type of organization, selected among the following categories: "LARGE ORGANIZATION," "SMALL DISADVANTAGED ORGANIZATION," "OTHER SMALL ORGANIZATION," "HBCU," "MI," "OTHER EDUCATIONAL," OR "OTHER NONPROFIT;"
- (5) Proposer's abstract reference number (if any);
- (6) Other team members (if applicable) and type of organization for each;
- (7) Proposal title;
- (8) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
- (9) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail;
- (10) Total funds requested from DARPA, and the amount of cost share (if any); AND
- (11) Date proposal was submitted.

B. Official transmittal letter.

Section II. Detailed Proposal Information - {see page limits above}

A. Executive Summary

A one-page executive summary outlining the proposed effort. The executive summary should contain:

1. A high-level overview of the proposed work;
2. Metrics used to define success;
3. Innovations made by the proposed work; AND
4. The cost of each phase.

B. Technical Approach

A detailed description of the technical approach, technical rationale, and constructive plan for accomplishment of technical goals in support of the innovative claims and deliverables. This section is the centerpiece of the proposal and should succinctly describe the uniqueness and benefits of the proposed approach. Proposers must include adequate detail and justification for any performer defined metrics and goals. In addition, a detailed analysis of how the proposed approach will meet both the DARPA and performer defined metrics must be provided. See Part II, Section I (A through C) for discussion of issues that should be responded to in the technical/management proposal.

C. Statement of Work (SOW)

In plain English, clearly define the technical tasks/subtasks to be performed, their durations, and dependencies among them. The page length for the SOW will be dependent on the amount of the effort. For each task/subtask, provide:

1. A general description of the objective (for each defined task/activity);
2. A detailed description of the approach to be taken to accomplish each defined task/activity;
3. Identification of the primary organization responsible for task execution (prime, sub, team member, by name, etc.);
4. The completion criteria for each task/activity - a product, event or milestone that defines its completion.
5. Define all deliverables (reporting, data, reports, software, etc.) to be provided to the Government in support of the proposed research tasks/activities; AND
6. Clearly identify any tasks/subtasks (prime or subcontracted) that will be accomplished on-campus at a university.

Note: Each Phase and Technical Area of the program must be separately defined in the SOW. Do not include any proprietary information in the SOW.

D. Deliverables

Deliverables associated with the proposed research. See Part II, Section I (A through C) for a minimum list of data and material deliverables for each Technical Area. For all technical areas, expected deliverables include quarterly technical status reports, monthly financial status reports, and a final report at the end of each phase. Include in this section all proprietary claims to the results, prototypes, Intellectual Property, or systems supporting and/or necessary for the use of the research, results, and/or prototype. If there are no proprietary claims, this should be stated. For forms to be completed regarding Intellectual Property, see Section VIII. There will be no page limit for the listed forms and the forms will not be included in the total page count.

E. State-of-the-Art Comparison

Comparison between the proposed work and the state-of-the-art (including current custom integrated circuit design flows) along with a general discussion of other research in this area. This section should be no more than 2 pages long.

F. Risk Mitigation Plan

Plan detailing risks and proposed activities to mitigate or respond to these risks. The risk plan should include a metric showing the probability of the risk occurring and another metric to capture the impact to the program. The impact of risks should be tied to the overall program objectives. This section should be no more than 1 page long.

G. Previous Accomplishments

Discussion of the proposer's previous accomplishments and work in closely related research areas, including design of custom integrated circuits. This section should be no more than 1 page long.

H. Facilities

Description of the facilities that would be used for the proposed effort. This section should be no more than 1 page long.

I. Schedules and milestones

Schedules and measurable milestones for the proposed research. (Note: Measurable milestones should capture key development points in tasks and should be clearly articulated and defined in time relative to start of effort.) Where the effort consists of multiple portions which could reasonably be partitioned for purposes of funding, these should be identified as options.

J. Summary Slide

One PowerPoint slide summarizing the proposed effort. A template PowerPoint slide will be provided on the BAA website as an attachment. Submit the PowerPoint file (do not convert PowerPoint file to pdf format) in addition to Volume I and Volume II of your full proposal. This summary slide does not count towards the total page count.

Section III. Additional Information

Information in this section may include a brief bibliography of relevant technical papers and research notes (published and unpublished) which document the technical ideas upon which the proposal is based. Copies of not more than three (3) relevant papers may be included in the submission.

b. Volume II, Cost Proposal – {No Page Limit}

All proposers, including FFRDCs, must submit the following:

Section I. Administrative

Cover sheet to include:

- (1) BAA number (DARPA-BAA-16-52);
- (2) Technical area(s);
- (3) Lead Organization submitting proposal;
- (4) Type of organization, selected among the following categories: “LARGE ORGANIZATION,” “SMALL DISADVANTAGED ORGANIZATION,” “OTHER SMALL ORGANIZATION,” “HBCU,” “MI,” “OTHER EDUCATIONAL,” OR “OTHER NONPROFIT;”
- (5) Proposer’s reference number (if any);
- (6) Other team members (if applicable) and type of organization for each;
- (7) Proposal title;
- (8) Technical point of contact to include: salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), electronic mail (if available);
- (9) Administrative point of contact to include: salutation, last name, first name, street address, city, state, zip code (+4), telephone, fax (if available), and electronic mail (if available);

- (10) Award instrument requested: cost-plus-fixed fee (CPFF), cost-contract—no fee, cost sharing contract – no fee, or other type of procurement contract (*specify*), or other transaction;
- (11) Place(s) and period(s) of performance;
- (12) Total proposed cost separated by basic award and option(s), if any, by calendar year and by government fiscal year;
- (13) Name, address, and telephone number of the proposer’s cognizant Defense Contract Management Agency (DCMA) administration office (*if known*);
- (14) Name, address, and telephone number of the proposer’s cognizant Defense Contract Audit Agency (DCAA) audit office (*if known*);
- (15) Date proposal was prepared;
- (16) DUNS number;
- (17) TIN number;
- (18) CAGE Code;
- (19) Subcontractor Information;
- (20) Proposal validity period; AND
- (21) Any Forward Pricing Rate Agreement, other such approved rate information, or such documentation that may assist in expediting negotiations (if available).

Attachment 1, the Cost Volume Proposer Checklist, must be included with the coversheet of the Cost Proposal.

Section II. Detailed Cost Information

The proposers, to include eligible FFRDCs, cost volume shall provide cost and pricing information (See Note 1), or other than cost or pricing information if the total price is under the referenced threshold, in sufficient detail to substantiate the program price proposed (e.g., realism and reasonableness). In doing so, the proposer shall provide, for both the prime and each subcontractor, a summary cost breakdown and a detailed cost breakdown by phase (if multiple phases are proposed), technical task/sub-task, and month for each technical area proposed to (Government fiscal year and calendar year). The breakdown/s shall include, at a minimum, the following major cost item along with associated backup documentation:

Total program cost broken down by major cost items:

- a. Direct Labor – a breakout clearly identifying the individual labor categories with associated labor hours and direct labor rates, as well as a detailed Basis-of-Estimate (BOE) narrative description of the methods used to estimate labor costs;
- b. Indirect Costs – Including Fringe Benefits, Overhead, General and Administrative Expense, Cost of Money, Fee, etc. (must show base amount and rate);
- c. Travel – Provide the purpose of the trip, number of trips, number of days per trip, departure and arrival destinations, number of people, etc.;
- d. Other Direct Costs – Itemized with costs; Back-up documentation is to be submitted to support proposed costs;
- e. Material/Equipment –
 - (i) A priced Bill-of-Material (BOM) clearly identifying, for each item proposed, the quantity, unit price, the source of the unit price (i.e., vendor quote,

engineering estimate, etc.), the type of property (i.e., material, equipment, special test equipment, information technology, etc.), and a cross-reference to the Statement of Work (SOW) task/s that require the item/s. At time of proposal submission, any item that exceeds \$1,000 must be supported with basis-of-estimate (BOE) documentation such as a copy of catalog price lists, vendor quotes or a written engineering estimate (additional documentation may be required during negotiations, if selected).

(ii) If seeking a procurement contract and items of Contractor Acquired Property are proposed, exclusive of material, the proposer shall clearly demonstrate that the inclusion of such items as Government Property is in keeping with the requirements of FAR Part 45.102. See Note 2 below.

- f. Consultants - If consultants are to be used, proposer must provide a copy of the consultant's proposed SOW as well as a signed consultant agreement or other document which verifies the proposed loaded daily / hourly rate and any other proposed consultant costs (e.g. travel);
- g. Subcontracts - Itemization of all subcontracts. Additionally, the prime contractor is responsible for compiling and providing, as part of its proposal submission to the Government, subcontractor proposals prepared at the same level of detail as that required by the prime. Subcontractor proposals include Interdivisional Work Transfer Agreements (ITWA) or similar arrangements. If seeking a procurement contract, the prime contractor shall provide a cost reasonableness analysis of all proposed subcontractor costs/prices. Such analysis shall indicate the extent to which the prime contractor has negotiated subcontract costs/prices and whether any such subcontracts are to be placed on a sole-source basis. All proprietary subcontractor proposal documentation, prepared at the same level of detail as that required of the prime and which cannot be uploaded to BAAT as part of the proposer's submission, shall be made immediately available to the Government, upon request, under separate cover (i.e., email), either by the proposer or by the subcontractor organization - this does not relieve the proposer from the requirement to include, as part of their submission (via BAAT), fully qualified subcontract proposals that do not include proprietary pricing information (rates, factors, etc.). A Rough Order of Magnitude (ROM), or similar budgetary estimate, is not considered a fully qualified subcontract cost proposal submission, and inclusion of such will result in the full proposal being deemed non-compliant;
- h. The source, nature, and amount of any industry cost-sharing;
- i. Written justification required per Part II, "Fundamental Research," pertaining to prime and/or subcontracted effort being considered Contracted Fundamental Research; AND
- j. Small Business Subcontracting Plan, if applicable. See Section VI(B)(6) "Subcontracting" below.

Proposers are strongly encouraged to provide the aforementioned cost breakdown as an editable MS Excel spreadsheet, inclusive of calculations formulae, with tabs (material, travel, ODC's) provided as necessary. The Government also requests and recommends that the Cost Proposal include MS Excel file(s) that provide traceability between the Bases of Estimate (BOEs) and the proposed costs across all elements and phases. This includes the calculations and adjustments

that are utilized to generate the Summary Costs from the source labor hours, labor costs, material costs, etc. input data. It is requested that the costs and Subcontractor proposals be readily traceable to the Prime Cost Proposal in the provided MS Excel file(s) – although this is not a requirement, providing information in this manner will assist the Government in understanding what is being proposed both technically and in terms of cost realism.

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 IT and equipment purchases, include a letter stating why the proposer cannot provide the requested resources from its own funding.

The cost proposal should include identification of pricing assumptions of which may require incorporation into the resulting award instrument (i.e., use of Government Furnished Property/Facilities/Information, access to Government Subject Matter Experts, etc.).

The proposer should include supporting cost and pricing information in sufficient detail to substantiate the summary cost estimates and should include a description of the method used to estimate costs and supporting documentation.

Cost proposals submitted by FFRDC's (prime or subcontractor) will be forwarded, if selected for negotiation, to their sponsoring organization contracting officer for review to confirm that all required forward pricing rates and factors have been used.

Proposers, other than universities, without an accounting system considered adequate for determining accurate costs must complete an SF 1408 if a cost type contract is to be negotiated. To facilitate this process, proposers should complete the SF 1408 found at <http://www.gsa.gov/portal/forms/download/115778> and submit the completed form with the proposal. To complete the form, check the boxes on the second page, then provide a narrative explanation of your accounting system to supplement the checklist on page one. For more information, please see http://www.dcaa.mil/preaward_accounting_system_adequacy_checklist.html.

Note 1:

(a) "Cost or Pricing Data" as defined in FAR 15.403-4 shall be required if the proposer is seeking a procurement contract per the referenced threshold, unless the proposer requests and is granted an exception from the requirement to submit cost or pricing data. Per DFARS 215.408(5), DFARS 252.215-7009, Proposal Adequacy Checklist, applies to all proposers/proposals seeking a FAR-based award (contract).

(b) In accordance with DFARS 15.403-1(4)(D), DoD has waived cost or pricing data requirements for nonprofit organizations (including educational institutions) on cost-reimbursement-no-fee contracts. In such instances where the waiver stipulated at DFARS 15.403-1(4)(D) applies, proposers shall submit information other than cost or pricing data to the extent necessary for the Government to determine price reasonableness and cost realism; and cost or pricing data from subcontractors that are not nonprofit organizations when the subcontractor's proposal exceeds the cost and pricing data threshold at FAR 15.403-4(a)(1).

(c) “Cost or pricing data” are not required if the proposer proposes an award instrument other than a procurement contract (i.e. other transaction agreement).

Note 2:

(a) In accordance with FAR 35.014, “Government property and title,” it is the Government’s intent that title to all equipment purchased with funds available for research under any resulting contract will vest in the acquiring nonprofit institution (e.g., Nonprofit Institutions of Higher Education and Nonprofit Organizations whose primary purpose is the conduct of scientific research) upon acquisition without further obligation to the Government. Any such equipment shall be used for the conduct of basic and applied scientific research. The above transfer of title to all equipment purchased with funds available for research under any resulting contract is not allowable when the acquiring entity is a for-profit organization; however, such organizations can, in accordance with FAR 52.245-1(j), be given priority to acquire such property at its full acquisition cost.

PLEASE NOTE, PROPOSERS ARE CAUTIONED THAT EVALUATION RATINGS MAY BE LOWERED AND/OR PROPOSALS REJECTED IF PROPOSAL PREPARATION (PROPOSAL FORMAT, CONTENT, ETC.) AND/OR SUBMITTAL INSTRUCTIONS ARE NOT FOLLOWED.

5. Submission Information

a. Abstract Submission Information

Proposers are strongly encouraged to submit an abstract in advance of a full proposal in order to provide potential proposers with a rapid response and to minimize unnecessary effort in proposal preparation and review. The time and date for submission of abstracts is specified in Section IV.B.6 (Submission Dates and Times) below. DARPA will acknowledge receipt of the submission and assign a control number that should be used in all further correspondence regarding the abstract.

Abstracts sent in response to DARPA-BAA-16-52 shall be submitted via DARPA's BAA Website (<https://baa.darpa.mil>). Visit the website to complete the two-step registration process. Submitters will need to register for an Extranet account (via the form at the URL listed above) and wait for two separate e-mails containing a username and temporary password. After accessing the Extranet, submitters may then create an account for the DARPA BAA website (via the "Register your Organization" link along the left side of the homepage), view submission instructions, and upload/finalize the abstract. Proposers using the DARPA BAA Website may encounter heavy traffic on the submission deadline date; it is highly advised that submission process be started as early as possible.

All abstracts submitted electronically through the DARPA BAA Submission website must be uploaded as zip files (.zip or .zipx extension). The final zip file should only contain the document(s) requested herein and must not exceed 50 MB in size. Only one zip file will be accepted per abstract; abstracts not uploaded as zip files will be rejected by DARPA.

NOTE: YOU MUST CLICK THE 'FINALIZE PROPOSAL ABSTRACT' BUTTON AT THE BOTTOM OF THE CREATE PROPOSAL ABSTRACT PAGE. FAILURE TO DO SO WILL RESULT IN YOUR ABSTRACT NOT BEING OFFICIALLY SUBMITTED TO THIS BAA AND THEREFORE NOT BEING REVIEWED.

Technical support for DARPA's BAA Website may be reached at BAAT_Support@darpa.mil, and is typically available during regular business hours, (9:00 AM - 5:00 PM EST Monday - Friday).

Abstracts may not be submitted by fax or e-mail; any so sent will be disregarded.

b. Proposal Submission Information

The typical proposal should express a consolidated effort in support of one or more related technical concepts or ideas. Disjointed efforts should not be included into a single proposal.

Proposals may not be submitted by fax or e-mail; any so sent will be disregarded.

Proposals not meeting the format described in the BAA may not be reviewed.

Proposers requesting contracts or other transaction agreements must submit proposals via DARPA's BAA Website (<https://baa.darpa.mil>). Note: If an account has already been created for the DARPA BAA Website, this account may be reused. If no account currently exists for the DARPA BAA Website, visit the website to complete the two-step registration process. Submitters will need to register for an Extranet account (via the form at the URL listed above) and wait for two separate e-mails containing a username and temporary password. After accessing the Extranet, submitters may then create an account for the DARPA BAA website (via the "Register your Organization" link along the left side of the homepage), view submission instructions, and upload/finalize the proposal. Proposers using the DARPA BAA Website may encounter heavy traffic on the submission deadline date; it is highly advised that submission process be started as early as possible.

All unclassified full proposals submitted electronically through the DARPA BAA website must be uploaded as zip files (.zip or .zipx extension). The final zip file should not exceed 50 MB in size. Only one zip file will be accepted per submission and submissions not uploaded as zip files will be rejected by DARPA.

Technical support for DARPA's BAA Website may be reached at BAAT_Support@darpa.mil, and is typically available during regular business hours (9:00 AM - 5:00 PM EST, Monday - Friday).

NOTE: YOU MUST CLICK THE 'FINALIZE FULL PROPOSAL' BUTTON AT THE BOTTOM OF THE CREATE FULL PROPOSAL PAGE. FAILURE TO DO SO WILL RESULT IN YOUR PROPOSAL NOT BEING OFFICIALLY SUBMITTED TO THIS BAA AND THEREFORE NOT BEING REVIEWED.

For a proposal that includes both classified and unclassified information, the proposal may be separated into an unclassified portion and a classified portion. The proposal should use the unclassified portion to the maximum extent reasonable. The unclassified portion can be submitted through the DARPA BAA Website, per the instructions above. When a proposal includes a classified portion, and when able according to security guidelines, we ask that proposers send an e-mail to DARPA-BAA-16-52@darpa.mil as notification that there is a classified portion to the proposal and to request submission instructions.

All administrative correspondence and questions on this solicitation, including requests for information on how to submit an abstract or full proposal to this BAA should be directed to DARPA-BAA-16-52@darpa.mil. DARPA intends to use electronic mail for correspondence regarding DARPA-BAA-16-52. Proposals and abstracts may not be submitted by fax or e-mail; any so sent will be disregarded. DARPA encourages use of the Internet for retrieving the BAA and any other related information that may subsequently be provided.

6. Submission Dates and Times

a. Abstract Date

Abstracts must be submitted to DARPA/MTO on or before 5:00 PM, Eastern Time, September 2, 2016. Abstracts received after this time and date may not be reviewed.

b. Full Proposal Date

Full proposals must be submitted to DARPA/MTO on or before 5:00 PM, Eastern Time, October 19, 2016, in order to be considered during the single round of selections. Proposals received after this deadline will not be reviewed.

DARPA will post a consolidated Question and Answer (FAQ) document on a regular basis. To access the posting go to: <http://www.darpa.mil/work-with-us/opportunities>. Under the DARPA-BAA-16-52 summary will be a link to the FAQ. Submit your question/s by e-mail to DARPA-BAA-16-52@darpa.mil. In order to receive a response sufficiently in advance of the proposal due date, send your question/s on or before 5:00 PM, Eastern Time, October 5, 2016.

DARPA will acknowledge receipt of complete submissions via email and assign control numbers that should be used in all further correspondence regarding proposals.

7. Funding Restrictions

Preaward costs will not be reimbursed unless a preaward cost agreement is negotiated prior to award.

8. Other Submission Requirements

Not Applicable.

V. Application Review Information

A. Evaluation Criteria

Proposals will be evaluated using the following criteria, listed in descending order of importance: (a) Overall Scientific and Technical Merit; (b) Potential Contribution and Relevance to the DARPA Mission; (c) Cost and Schedule Realism; and (d) Proposer's Capabilities and/or Related Experience.

(a) Overall Scientific and Technical Merit

The proposed technical approach is feasible, achievable, complete and supported by a proposed technical team that has the expertise and experience to accomplish the proposed tasks.

Task descriptions and associated technical elements provided are complete and in a logical sequence with all proposed deliverables clearly defined such that a final outcome that achieves the goal can be expected as a result of award. The proposal identifies major technical risks and planned mitigation efforts are clearly defined and feasible.

(b) Potential Contribution and Relevance to the DARPA Mission

The potential contributions of the proposed effort are relevant to the national technology base. Specifically, DARPA's mission is to maintain the technological superiority of the U.S. military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their application.

(c) Cost and Schedule Realism

The proposed costs are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. The proposed costs are consistent with the proposer's Statement of Work and reflect a sufficient understanding of the costs and level of effort needed to successfully accomplish the proposed technical approach. The costs for the prime proposer and proposed subawardees are substantiated by the details provided in the proposal (e.g., the type and number of labor hours proposed per task, the types and quantities of materials, equipment and fabrication costs, travel and any other applicable costs).

It is expected that the effort will leverage all available relevant prior research in order to obtain the maximum benefit from the available funding. For efforts with a likelihood of commercial application, appropriate direct cost sharing may be a positive factor in the evaluation. DARPA recognizes that undue emphasis on cost may motivate proposers 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. DARPA discourages such cost strategies.

The proposed schedule aggressively pursues performance metrics in the shortest timeframe and accurately accounts for that timeframe. The proposed schedule identifies and mitigates any potential schedule risk.

(d) Proposer's Capabilities and/or Related Experience

The proposer's prior experience in similar efforts clearly demonstrates an ability to deliver products that meet the proposed technical performance within the proposed budget and schedule. The proposed team has the expertise to manage the cost and schedule. Similar efforts completed/ongoing by the proposer in this area are fully described including identification of other Government sponsors.

B. Review and Selection Process

DARPA will conduct a scientific/technical review of each conforming proposal. Proposals will not be evaluated against each other since they are not submitted in accordance with a common work statement. DARPA's intent is to review proposals as soon as possible after they arrive; however, proposals may be reviewed periodically for administrative reasons.

Award(s) will be made to proposers whose proposals are determined to be the most advantageous to the Government, all factors considered, including the potential contributions of the proposed work to the overall research program and the availability of funding for the effort.

It is the policy of DARPA 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. Pursuant to FAR 35.016, the primary basis for selecting proposals for acceptance shall be technical, importance to agency programs, and fund availability. In order to provide the desired evaluation, qualified Government personnel will conduct reviews and (if necessary) convene panels of experts in the appropriate areas.

For evaluation purposes, a proposal is the document described in "Full Proposal Format," Section IV.B.4. Other supporting or background materials submitted with the proposal will be considered for the reviewer's convenience only and not considered as part of the proposal.

Restrictive notices notwithstanding, support contractors may handle proposals for administrative purposes. These support contractors are prohibited from competition in DARPA technical research and are bound by appropriate non-disclosure requirements.

Subject to the restrictions set forth in FAR 37.203(d), input on technical aspects of the proposals may be solicited by DARPA from non-Government consultants/experts who are strictly bound by the appropriate non-disclosure requirements.

VI. Award Administration Information

A. Selection Notices

As soon as the evaluation of a proposal is complete, the proposer will be notified that (1) the proposal has been selected for funding pending contract negotiations, or (2) the proposal has not been selected. These official notifications will be sent via email to the Technical POC identified on the proposal coversheet.

B. Administrative and National Policy Requirements

1. Meeting and Travel Requirements

All key participants are required to attend the program kickoff meeting. Performers should also anticipate semi-annual program-wide PI Meetings and periodic site visits at the Program Manager's discretion.

2. Human Subjects Research

All research selected for funding involving human subjects, to include use of human biological specimens and human data, must comply with the federal regulations for human subjects protection. Further, research involving human subjects that is conducted or supported by the DoD must comply with 32 CFR 219, Protection of Human Subjects (and DoD Instruction 3216.02, Protection of Human Subjects and Adherence to Ethical Standards in DoD-Supported Research (<http://www.dtic.mil/whs/directives/corres/pdf/321602p.pdf>)).

Institutions awarded funding for research involving human subjects must provide documentation of a current Assurance of Compliance with Federal regulations for human subjects protection, such as a Department of Health and Human Services, Office of Human Research Protection Federal Wide Assurance (<http://www.hhs.gov/ohrp>). All institutions engaged in human subjects research, to include subawardees, must also hold a valid Assurance. In addition, all personnel involved in human subjects research must provide documentation of completion of human subjects research training.

For all proposed research that will involve human subjects in the first year or phase of the project, the institution must provide evidence of or a plan for review by an Institutional Review Board (IRB) upon final proposal submission to DARPA as part of their proposal, prior to being selected for funding. The IRB conducting the review must be the IRB identified on the institution's Assurance of Compliance with human subjects protection regulations. The protocol, separate from the proposal, must include a detailed description of the research plan, study population, risks and benefits of study participation, recruitment and consent process, data collection, and data analysis. It is recommended that you consult the designated IRB for guidance on writing the protocol. The informed consent document must comply with federal regulations (32 CFR 219.116). A valid Assurance of Compliance with human subjects protection regulations along with evidence of completion of appropriate human subjects research

training by all investigators and personnel involved with human subjects research should accompany the protocol for review by the IRB.

In addition to a local IRB approval, a headquarters-level human subjects administrative review and approval is required for all research conducted or supported by the DoD. The Army, Navy, or Air Force office responsible for managing the award can provide guidance and information about their component's headquarters-level review process. Note that confirmation of a current Assurance of Compliance with human subjects protection regulations and appropriate human subjects research training is required before headquarters-level approval can be issued.

The time required to complete the IRB review/approval process varies depending on the complexity of the research and the level of risk involved with the study. The IRB approval process can last between one and three months, followed by a DoD review that could last between three and six months. Ample time should be allotted to complete the approval process. DoD/DARPA funding cannot be used towards human subjects research until ALL approvals are granted.

3. Animal Use

Award recipients performing research, experimentation, or testing involving the use of animals shall comply with the rules on animal acquisition, transport, care, handling, and use as outlined in: (i) 9 CFR parts 1-4, Department of Agriculture rules that implement the Animal Welfare Act of 1966, as amended, (7 U.S.C. § 2131-2159); (ii) National Institutes of Health Publication No. 86-23, "Guide for the Care and Use of Laboratory Animals" (8th Edition); and (iii) DoD Instruction 3216.01, "Use of Animals in DoD Programs."

For projects anticipating animal use, proposals should briefly describe plans for Institutional Animal Care and Use Committee (IACUC) review and approval. Animal studies in the program will be expected to comply with the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals, available at <http://grants.nih.gov/grants/olaw/olaw.htm>.

All award recipients must receive approval by a DoD-certified veterinarian, in addition to an IACUC approval. No animal studies may be conducted using DoD/DARPA funding until the United States Army Medical Research and Materiel Command (USAMRMC) Animal Care and Use Review Office (ACURO) or other appropriate DoD veterinary office(s) grant approval. As a part of this secondary review process, the award recipient will be required to complete and submit an ACURO Animal Use Appendix, which may be found at https://mrmc-www.army.mil/index.cfm?pageid=Research_Protections.acuro&rn=1.

4. Export Control

Per DFARS 225.7901-4, all procurement contracts, other transactions and other awards, as deemed appropriate, resultant from this solicitation will include the DFARS Export Control clause (252.225-7048).

5. Subcontracting

Pursuant to Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)), it is the policy of the Government to enable small business 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 proposer who submits a contract proposal and includes subcontractors is required to submit a subcontracting plan in accordance with FAR 19.702(a)(1) should do so with their proposal. The plan format is outlined in FAR 19.704.

6. Electronic and Information Technology

All electronic and information technology acquired through this solicitation must satisfy the accessibility requirements of Section 508 of the Rehabilitation Act (29 U.S.C. § 794d) and FAR 39.2. Each proposer who submits a proposal involving the creation or inclusion of electronic and information technology must ensure that federal employees with disabilities will have access to and use of information that is comparable to the access and use by Federal employees who are not individuals with disabilities and members of the public with disabilities seeking information or services from DARPA will have access to and use of information and data that is comparable to the access and use of information and data by members of the public who are not individuals with disabilities.

7. Employment Eligibility Verification

As per FAR 22.1802, recipients of FAR-based procurement contracts must enroll as federal contractors in E-verify and use the system to verify employment eligibility of all employees assigned to the award. All resultant contracts from this solicitation will include FAR 52.222-54, "Employment Eligibility Verification." This clause will not be included in grants, cooperative agreements, or Other Transactions.

8. Reserved

9. System for Award Management (SAM) and Universal Identifier Requirements

Unless the proposer is exempt from this requirement, as per FAR 4.1102 or 2 CFR 25.110 as applicable, all proposers must be registered in the System for Award Management (SAM) and have a valid Data Universal Numbering System (DUNS) number prior to submitting a proposal. All proposers must maintain an active registration in SAM with current information at all times during which they have an active Federal award or proposal under consideration by DARPA. All proposers must provide the DUNS number in each proposal they submit.

Information on SAM registration is available at www.sam.gov.

10. Reporting Executive Compensation and First-Tier Subcontract Awards

FAR clause 52.204-10, “Reporting Executive Compensation and First-Tier Subcontract Awards,” will be used in all procurement contracts valued at \$25,000 or more. A similar award term will be used in all grants and cooperative agreements.

11. Updates of Information Regarding Responsibility Matters

Per FAR 9.104-7(c), FAR clause 52.209-9, Updates of Publicly Available Information Regarding Responsibility Matters, will be included in all contracts valued at \$500,000 or more where the contractor has current active Federal contracts and grants with total value greater than \$10,000,000.

12. Representations by Corporations Regarding an Unpaid Delinquent Tax Liability or a Felony Conviction under any Federal Law

The following representation will be included in all awards:

(a) In accordance with section 101(a) of the Continuing Appropriations Act, 2016 (Pub. L. 114-53) and any subsequent FY 2016 appropriations act that extends to FY 2016 funds the same restrictions as are contained in sections 744 and 745 of division E, title VII, of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235), none of the funds made available by this or any other Act may be used to enter into a contract with any corporation that —

- (1) Has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, where the awarding agency is aware of the unpaid tax liability, unless the agency has considered suspension or debarment of the corporation and made a determination that this further action is not necessary to protect the interests of the Government; or
- (2) Was convicted of a felony criminal violation under any Federal law within the preceding 24 months, where the awarding agency is aware of the conviction, unless the agency has considered suspension or debarment of the corporation and made a determination that this action is not necessary to protect the interests of the Government.

(b) The Offeror represents that —

- (1) It is [] is not [] a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability,
- (2) It is [] is not [] a corporation that was convicted of a felony criminal violation under a Federal law within the preceding 24 months.

13. Cost Accounting Standards (CAS) Notices and Certification

As per FAR 52.230-2, any procurement contract in excess of the referenced threshold resulting from this solicitation will be subject to the requirements of the Cost Accounting Standards Board (48 CFR 99), except those contracts which are exempt as specified in 48 CFR 9903.201-1. Any proposer submitting a proposal which, if accepted, will result in a CAS compliant contract, must submit representations and a Disclosure Statement as required by 48 CFR 9903.202 detailed in FAR 52.230-2. The disclosure forms may be found at http://www.whitehouse.gov/omb/procurement_casb.

14. Controlled Unclassified Information (CUI) on Non-DoD Information Systems

Controlled Unclassified Information (CUI) refers to unclassified information that does not meet the standards for National Security Classification but is pertinent to the national interests of the United States or to the important interests of entities outside the Federal Government and under law or policy requires protection from unauthorized disclosure, special handling safeguards, or prescribed limits on exchange or dissemination. All non-DoD entities doing business with DARPA are expected to adhere to the following procedural safeguards, in addition to any other relevant Federal or DoD specific procedures, for submission of any proposals to DARPA and any potential business with DARPA:

- Do not process DARPA CUI on publicly available computers or post DARPA CUI to publicly available webpages or websites that have access limited only by domain or Internet protocol restriction.
- Ensure that all DARPA CUI is protected by a physical or electronic barrier when not under direct individual control of an authorized user and limit the transfer of DARPA CUI to subawardees or teaming partners with a need to know and commitment to this level of protection.
- Ensure that DARPA CUI on mobile computing devices is identified and encrypted and all communications on mobile devices or through wireless connections are protected and encrypted.
- Overwrite media that has been used to process DARPA CUI before external release or disposal.

15. Safeguarding of Covered Defense Information and Cyber Incident Reporting

Per DFARS 204.7304, DFARS 252.204-7012, “Safeguarding of Covered Defense Information and Cyber Incident Reporting,” applies to this solicitation and all FAR-based awards resulting from this solicitation.

16. Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements

(a) In accordance with section 101(a) of the Continuing Appropriations Act, 2016 (Pub. L. 114-53) and any subsequent FY 2016 appropriations act that extends to FY 2016 funds the same restrictions as are contained in section 743 of division E, title VII, of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235), none of the funds appropriated (or otherwise made available) by this or any other Act may be used for a contract with an entity that requires employees or subcontractors of such entity seeking to report fraud, waste, or abuse to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contactors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

(b) The prohibition in paragraph (a) of this provision does not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(c) *Representation.* By submission of its offer, the Offeror represents that it does not require employees or subcontractors of such entity seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or contactors from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

C. Reporting

The number and types of reports will be specified in the award document, but will include as a minimum, quarterly technical and monthly financial status reports. The reports shall be prepared and submitted in accordance with the procedures contained in the award document and mutually agreed on before award. Reports and briefing material will also be required as appropriate to document progress in accomplishing program metrics. A Final Report that summarizes the project and tasks will be required at the conclusion of the performance period for the award, notwithstanding the fact that the research may be continued under a follow-on vehicle.

D. Electronic Systems

1. Representations and Certifications

In accordance with FAR 4.1201, prospective proposers shall complete electronic annual representations and certifications at www.sam.gov.

2. Wide Area Work Flow (WAWF)

Unless using another means of invoicing, performers will be required to submit invoices for payment directly via to <http://wawf.eb.mil>. Registration in WAWF will be required prior to any award under this BAA.

3. i-Edison

The award document for each proposal selected for funding will contain a mandatory requirement for patent reports and notifications to be submitted electronically through i-Edison (<https://public.era.nih.gov/iedison>).

VII. Agency Contacts

Administrative, technical or contractual questions should be sent via e-mail to DARPA-BAA-16-52@darpa.mil. All requests must include the name, email address, and phone number of a point of contact.

The technical POC for this effort is:

Mr. Trung Tran
DARPA/MTO
ATTN: DARPA-BAA-16-52
675 North Randolph Street
Arlington, VA 22203-2114
Email: DARPA-BAA-16-52@darpa.mil

VIII. Other Information

A. Intellectual Property Procurement Contract Proposers

1. Noncommercial Items (Technical Data and Computer Software)

Proposers responding to this BAA requesting a procurement contract to be issued under the FAR/DFARS shall identify 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. Proposers shall follow the format under DFARS 252.227-7017 for this stated purpose. In the event that proposers do not submit the list, 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 proposers should identify the data and software in question, as subject to Government Purpose Rights (GPR). In accordance with DFARS 252.227-7013 Rights in Technical Data - Noncommercial Items, and DFARS 252.227-7014 Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation, the Government will automatically assume that any such GPR restriction is limited to a period of five (5) years in accordance with the applicable DFARS clauses, at which time the Government will acquire “unlimited rights” unless the parties agree otherwise. Proposers are advised that the Government will use the list during the evaluation

process to evaluate the impact of any identified restrictions and may request additional information from the proposer, as may be necessary, to evaluate the proposer’s assertions. If no restrictions are intended, then the proposer should state “NONE.” It is noted an assertion of “NONE” indicates that the Government has “unlimited rights” to all noncommercial technical data and noncommercial computer software delivered under the award instrument, in accordance with the DFARS provisions cited above. Failure to provide full information may result in a determination that the proposal is not compliant with the BAA – resulting in nonselectability of the proposal.

A sample list for complying with this request is as follows:

NONCOMMERCIAL				
Technical Data Computer Software To be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

2. Commercial Items (Technical Data and Computer Software)

Proposers responding to this BAA requesting a procurement contract to be issued under the FAR/DFARS shall identify all commercial technical data and commercial computer software that may be embedded 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 proposers 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 evaluation process to evaluate the impact of any identified restrictions and may request additional information from the proposer, as may be necessary, to evaluate the proposer’s assertions. If no restrictions are intended, then the proposer should state “NONE.” Failure to provide full information may result in a determination that the proposal is not compliant with the BAA – resulting in nonselectability of the proposal.

A sample list for complying with this request is as follows:

COMMERCIAL				
Technical Data Computer Software To be Furnished With Restrictions	Summary of Intended Use in the Conduct of the Research	Basis for Assertion	Asserted Rights Category	Name of Person Asserting Restrictions
(LIST)	(NARRATIVE)	(LIST)	(LIST)	(LIST)

B. Non-Procurement Contract Proposers – Noncommercial and Commercial Items (Technical Data and Computer Software)

Proposers responding to this BAA requesting a Grant, Cooperative Agreement, Technology Investment Agreement, or Other Transaction for Prototype shall follow the applicable rules and regulations governing these various award instruments, but in all cases should appropriately identify any potential restrictions on the Government’s use of any Intellectual Property contemplated under those award instruments in question. This includes both Noncommercial Items and Commercial Items. Although not required, proposers may use a format similar to that described in Paragraphs 1.a and 1.b above. The Government may use the list during the evaluation process to evaluate the impact of any identified restrictions, and may request additional information from the proposer, as may be necessary, to evaluate the proposer’s assertions. If no restrictions are intended, then the proposer should state “NONE.” Failure to provide full information may result in a determination that the proposal is not compliant with the BAA – resulting in nonselectability of the proposal.

C. All Proposers – Patents

Include documentation proving your 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 your proposal for the DARPA program. If a patent application has been filed for an invention that your proposal utilizes, but the application has not yet been made publicly available and contains proprietary information, you 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 you own the invention, or (2) proof of possession of appropriate licensing rights in the invention.

D. All Proposers – Intellectual Property Representations

Provide a good faith representation that you either own or possess appropriate licensing rights to all other intellectual property that will be utilized under your proposal for the DARPA program. Additionally, proposers shall provide a short summary for each item asserted with less than unlimited rights that describes the nature of the restriction and the intended use of the intellectual property in the conduct of the proposed research.

E. Other Transactions (OTs):

DARPA is able to obtain its research support through a variety of legal instruments and flexible arrangements, to include use of Other Transactions (OTs). OTs are potentially applicable to a wide variety of DARPA programs. They are likely to be particularly applicable to support dual-use technologies (those with commercial nonmilitary potential as well as potential military applications), consortia or multi-party agreements, and work supported by multiple funding sources. Because OTs are not traditional procurement contracts, DARPA is not required to include the traditional FAR and DFARS clauses in these agreements, but is free to negotiate provisions that are mutually agreeable to both the Government and the consortium of companies

entering into the agreement. Proposals may, but need not, state that an OT rather than a contract or grant is desired. Furthermore, DARPA does not enter into OTs when a contract or grant is feasible or appropriate. See FAR 35.003 for Government-wide policy on use of contracts for research and development. Potential proposers are encouraged to visit the DARPA Contracts Management page (<http://www.darpa.mil/work-with-us/contractmanagement>) for more information regarding the use of OTs.

All proposers requesting an OT must include a detailed list of milestones. Each such milestone must include the following: milestone description, completion criteria, due date, payment/funding schedule (to include, if cost share is proposed, contractor and Government share amounts). It is noted that, at a minimum, such milestones should relate directly to accomplishment of program technical metrics as defined in the BAA and/or the proposer's proposal.

Agreement type will be subject to negotiation by the Agreements Officer. If the proposer requests award of an OT for Prototype as a nontraditional defense contractor, information must be included in the cost proposal to support the claim. Additionally, if the proposer requests award of an OT for Prototype, without the required one-third (1/3) cost share, information must be included in the cost proposal supporting that there is at least one non-traditional defense contractor participating to a significant extent in the proposed prototype project.

F. Proposers Day

The HIVE Proposers Day will be held on August 11, 2016 in Arlington, VA. Advance registration is required. See DARPA-SN-16-49, posted at www.fbo.gov, for all details. Attendance at the HIVE Proposers Day is not required to propose to this solicitation.

Attachment 1

The following checklist is provided to assist the proposer in developing a complete and responsive cost volume. Full instructions appear within this BAA. **This worksheet must be included with the coversheet of the Cost Proposal.**

1. Are all items from section "Volume II, Cost Proposal" included on your Cost Proposal cover sheet?

YES NO

If reply is "No", please explain:

2. Does your Cost Proposal include (1) a summary cost buildup by Phase, (2) a summary cost buildup by Year, and (3) a detailed cost buildup of for each Phase that breaks out each task and shows the cost per month?

YES NO **Appears on Page(s)** [Type text]

If reply is "No", please explain:

3. Does your cost proposal (detailed cost buildup #3 above in item 2) show a breakdown of the major cost items listed below:

Direct Labor (Labor Categories, Hours, Rates)

YES NO **Appears on Page(s)** [Type text]

Indirect Costs/Rates (i.e., overhead charges, fringe benefits, G&A)

YES NO **Appears on Page(s)** [Type text]

Materials and/or Equipment

YES NO **Appears on Page(s)** [Type text]

Subcontracts/Consultants

YES NO **Appears on Page(s)** [Type text]

Other Direct Costs

YES NO **Appears on Page(s)** [Type text]

Travel

YES NO **Appears on Page(s)** [Type text]

If reply is "No", please explain:

If reply is "No", please explain:

12. If requesting a FAR-based contract, does your cost proposal include a tech/cost analysis for all proposed subcontractors?

YES NO **Appears on Page(s)** [Type text]

If reply is "No", please explain:

13. Have all team members (prime and subcontractors) who are considered a Federally Funded Research & Development Center (FFRDC) or Government entity included documentation that clearly demonstrates work is not otherwise available from the private sector AND provided a letter on letterhead from the sponsoring organization citing the specific authority establishing their eligibility to propose to government solicitations and compete with industry?

YES NO **Appears on Page(s)** [Type text]

If reply is "No", please explain:

14. Does your proposal include a response regarding Organizational Conflicts of Interest?

YES NO **Appears on Page(s)** [Type text]

If reply is "No", please explain:

15. Does your proposal include a completed Data Rights Assertions table/certification?

YES NO **Appears on Page(s)** [Type textggg]

If reply is "No", please explain:

"16. """"Do you possess a DCAA-approved cost accounting system?

YES NO **Appears on Page(s)**

If reply is "Yes", and you are seeking a cost reimbursement contract, please provide a copy of this approval with your cost proposal. **Appears on Page(s)**

If reply is "No", and you are seeking a cost reimbursement contract, please provide a completed SF 1408 with your cost proposal. **Appears on Page(s)**



Guidance for HIVE proposal summary slide

- Follow the general guidance in each of the following quadrants.
- Provide a concise and informative summary of your proposal.
- Unclassified information only.
- Maximum of one slide.
- Include images and figures where appropriate.
- Please submit in MS PowerPoint (preferred) or equivalent file format.



Proposal Title

Proposing organization | Principal Investigator | Total budget | List of subcontractors

Innovative Claims

- What is the problem? Why is the solution challenging?
- How is it done today, and what are the limits of current practice?
- What is unique about your approach? Why will it succeed?
- What are the limitations (if any) to your approach? How will you compensate for them?
- Include a graphic that summarizes the proposed effort if supportive.

Team organization, cost, milestones and schedule

- Show the proposed team organization, cost, technical milestones (intermediate and end-of-phase milestones), and project schedule.
- List the proposed deliverables: data, reports, software, simulations, prototype components, etc.

Technical Rationale and Approach(es)

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- Outline clearly how you plan to accomplish technical goals and program metrics stated in the BAA.
- What are the fundamental performance vs. SWaP trade-offs?
- What enabling technology is needed for this technology approach? Is it currently available, commercial off the shelf?
- What are the major technical risk elements and how do you plan to address/mitigate them?
- Include a figure that captures the technical approach if supportive.

Technical Area

- Which technical area does this proposal address?
- List relevant experience in the technical area which will contribute to the success of the effort?
- List the proposed performance goals and timeline as quantitative metrics.
- Are there any dual-use applications enabled by this technology?