BROAD AGENCY ANNOUNCEMENT (BAA)

Explosives Division (EXD) BAA 13-05

Advanced X-ray Material Discrimination

White Papers Due: See Anticipated Schedule of Events in paragraph 4.6
Full Proposals Due: See Anticipated Schedule of Events in paragraph 4.6

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Amendment 00006

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1 GENERAL INFORMATION

1.1 Introduction

This solicitation is a Broad Agency Announcement (BAA) issued under the provisions of paragraph 6.102(d)(2) of the Federal Acquisition Regulation (FAR) to provide for the competitive selection of research proposals. A formal Request for Proposal (RFP) will not be issued. The Department of Homeland Security (DHS) Science & Technology (S&T) Directorate is soliciting white papers which will be evaluated in accordance with this BAA. From the submitted and evaluated white papers, participants may be invited to submit full proposals under this BAA. Contracts based on responses to this BAA are considered to be the result of full and open competition and in full compliance with the provisions of Public Law (PL) 98-369, "The Competition in Contracting Act of 1984." Awards under this BAA are planned in Fiscal Year (FY) 2013. Currently no funds are committed for any contract awards that may be selected pursuant to this BAA. No contract awards will be made until appropriated funds are available from which payment for contract purposes can be made.

1.2 Agency Name

Department of Homeland Security
Science & Technology Directorate
Explosives Division
Washington, DC

1.3 Research Opportunity Title

Advanced X-ray Material Discrimination

1.4 Program Name

Checked Baggage and Checkpoint

1.5 Research Opportunity Number

BAA 13-05

1.6 Solicitation and Response Approach

The Department of Homeland Security Science & Technology Directorate (DHS S&T) will not issue paper copies of this announcement. DHS S&T reserves the right to select for award and fund all, some, or none of the submissions received in response to this solicitation. No funding for direct reimbursement of white paper or proposal development costs will be allowed. White Papers, Full Proposals or any other material submitted in response to this BAA will not be returned. However, DHS S&T will adhere to FAR policy on handling source selection information and proprietary proposals in accordance with any and all markings on the proposal. It is the policy of DHS S&T to treat all proposals as sensitive competitive information and to disclose their contents only for the purposes of evaluation. All submissions should be unclassified. Documents containing sensitive information that are not suitable for uncontrolled public dissemination should be marked

"For Official Use Only" (FOUO). When transmitted electronically, FOUO proposals should be sent with password protection.

Award type is anticipated to be in the form of a Cost Reimbursement type contract or other transaction agreement, if authorized at time of award. In the event an Offeror or subcontractor is an FFRDC, Department of Energy National Laboratory, or other Federally funded entity, DHS S&T will work with the appropriate sponsoring agency to issue an interagency agreement pursuant to the Economy Act (31 U.S.C. 1531) or other appropriate authority.

A two-step proposal selection process will be used for this solicitation to minimize the cost and effort for prospective offerors. Step 1 will consist of the solicitation, receipt, and evaluation of White Papers using a standardized DHS S&T Explosives Division "Project Proposal Form" template from offerors (see Appendix I). Entries in the various sections of the Project Proposal Forms (and White Paper) should be concise and conform to the specified formatting limitations. No formal transmittal letter is required for the Step 1, White Paper submission.

An evaluation process will be conducted by DHS S&T and the Step 1 White Paper selectees will be encouraged to participate in Step 2, which will consist of the solicitation, receipt, and evaluation of a Full Proposal. The Full Proposals will be page limited depending upon the Task Area as noted in section 4.4. The page count limit excludes the proposer's Formal Transmittal Letter, Cover Page and Table of Contents. The page limit exclusion also applies to resumes/biographical information, Teaming Agreements, Letters of Intent (LOI) and Memorandum of Agreement (MOA)/Memorandum of Understanding (MOU) and Assertion of Data Rights if and only if the main proposal write-up (within the page limitation) makes reference to the respective aforementioned items by referring to the appropriate appendix section containing the items.

1.7 Response Dates

White Paper Proposals Due: See Anticipated Schedule of Events in paragraph 4.6
Full Proposals Due: See Anticipated Schedule of Events in paragraph 4.6.

1.8 Research Opportunity Description

1.8.1 Background

The Homeland Security Act of 2002 (Public Law 107-296) states that DHS S&T will "support basic and applied homeland security research to promote revolutionary changes in technologies; advance the development, testing and evaluation, and deployment of critical homeland security technologies; and accelerate the prototyping and deployment of technologies that would address homeland security vulnerabilities."[1]

[1] 6 U.S.C. § 187(b)(3)(A-C)

The DHS S&T Checked Baggage and Check Point Programs invest in the development and maturation of advanced screening technologies that demonstrate a potential to deliver solutions that address TSA's capability gaps for screening checked baggage and personal carry-on items. Specifically, the programs pursue technologies that:

- Significantly improve the capability to detect current and emerging improvised explosive threats
- Demonstrate the potential to deliver improved probability of detection (Pdet) and reduced probability of false alarm (Pfa) for an expanded improvised explosive library of threats, improve system reliability, and provide higher screening throughput with 0.5 m/sec as a goal.
- Reduce both procurement and lifecycle costs and require minimal modification of existing TSA Concept of Operations (CONOPS) for deployment

TSA's system requirements along with their cost and operational models must be met as new technologies are developed. TSA has a Mission Needs Statement (MNS), Operational Requirements Document (ORD) and Functional Requirements Documents (FRD) for EDS[2] and AT[3] systems that will guide and frame the technology development on this BAA in order to successfully transition technology developed on a future system development acquisition and BAA. Access to the TSA documents will not be required by Performers on this BAA; DHS S&T will provide the technical direction on key technologies and needs to the Performers.

1.8.2 The Problem

The emergence of improvised explosive threats and their use by terrorists has placed many challenges on the aviation security screening layers. EDS and AT X-ray equipment have been presented with considerable challenges in developing a broad detection capability for improvised explosive threats during security screening of checked bags and carry-on items.

Technologies are needed that increase the measurement or mathematical discrimination between improvised explosive threats and stream-of-commerce clutter in checked baggage and carry-on items. Conventional EDS utilizes two basic discriminating signatures: effective atomic number and density of screened objects. R&D is needed to identify additional discriminating signatures between improvised explosive threats and stream-of-commerce clutter to improve detection capability with reduced false alarm rates.

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[2] EDS: Explosive Detection System; TSA term for equipment used in Checked Baggage Screening utilizing X-rays and employing 3-D Computed Tomography. http://www.tsa.gov/about-tsa/security-technologies#eds

[3] AT: Advanced Technology; TSA term for equipment used in the Checkpoint employing X-rays to screen carry-on items and typically has only a few views unlike EDS that has many views representing the objects scanned. For more detail on the TSA Passenger Screening Program, see http://www.dhs.gov/xlibrary/assets/recovery/tsa_recovery_passenger_screening_program.pdf

1.8.3 BAA Overview

This BAA will advance aviation security and improvised explosive threat detection by providing enabling technology for subsequent incorporation into EDS and AT screening equipment by future development acquisitions as illustrated in Figure 1.

The primary technical focus is significantly enhancing capabilities for improvised explosive threat detection by reducing false alarm rates on multiple improvised explosive threat classes with improved probability of detection, while increasing screening throughput, supporting TSA's risk-based screening, and reducing equipment life-cycle costs.

This BAA seeks new system solutions employing revolutionary technologies capable of offering significant enhancement to the overall detection capability metrics. Minor or incremental improvements are not of interest for this BAA. Transition periods of 4-5 years are anticipated; however S&T has interest in technologies that may offer nearer term retrofit capability into the deployed EDS and AT platforms.

Achieving revolutionary enhancements in improvised explosive threat detection requires new techniques for distinguishing the stream-of-commerce bag clutter from improvised explosive threats.

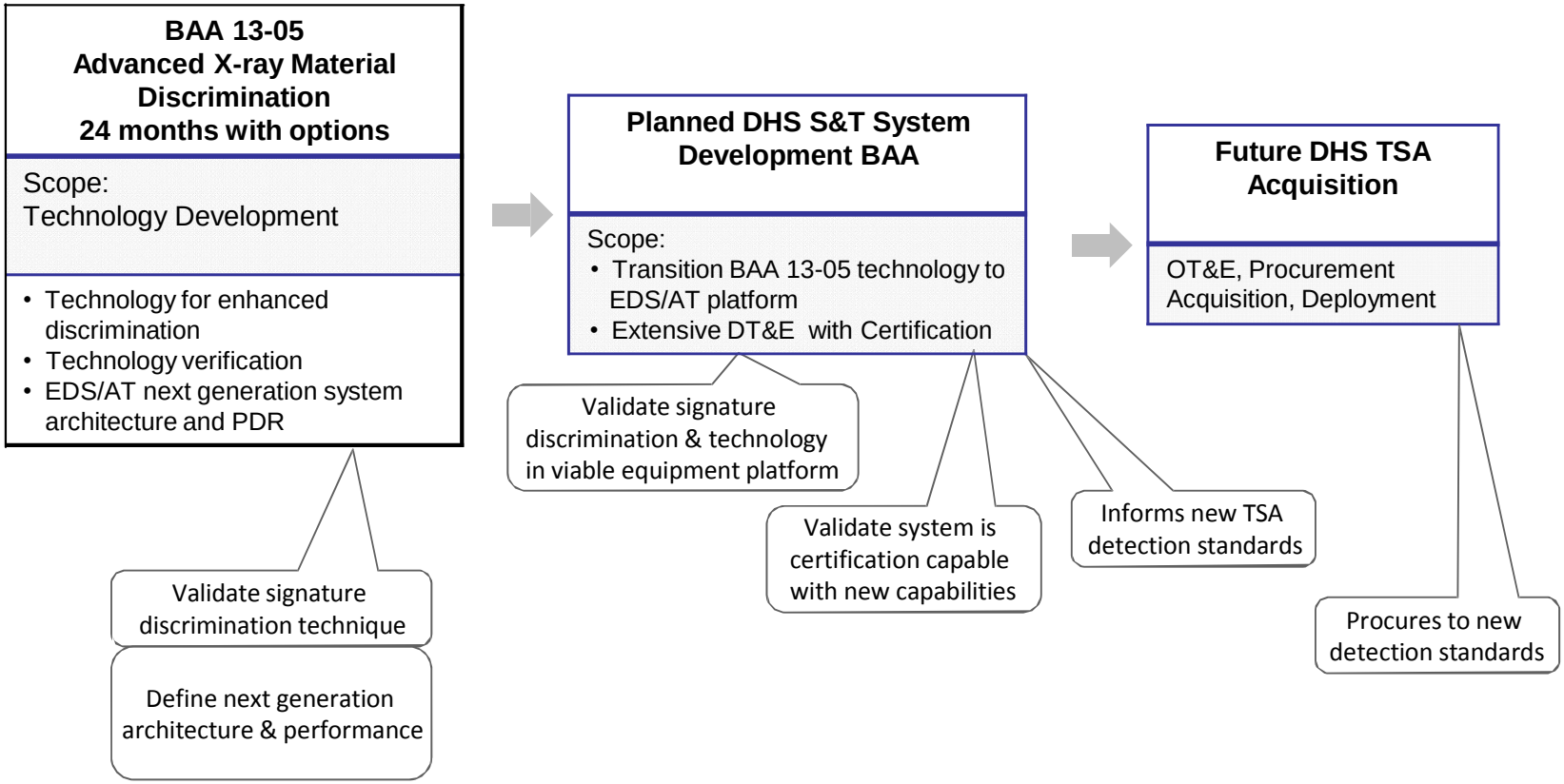
Towards these goals, this BAA solicits responses to the following five task areas:

1) Task Area 1: X-ray Test Bed Prototypes
2) Task Area 2: Supporting Analytical Tasks
3) Task Area 3: Test and Evaluation Support
4) Task Area 4: Architectural Components
5) Task Area 5: X-Ray System Architectural Design Concepts

A specialized X-ray test bed employing new signature measurement techniques will be utilized to perform improvised explosive threat and clutter characterization. Additional characterization of stream-of-commerce clutter will occur from data collection at airports. The measured data, supplemented with airport-collected, stream-of-commerce data will be provided to multiple teams performing system architecture design, information theory analysis and algorithm development. Vendors' EDS and AT equipment will also be used for signature data collection and evaluation on broad improvised explosive threat classes to thoroughly assess areas for improvement and provide insights to guide all task areas.

DHS S&T expects to make multiple awards for each Task Area (Task Areas 1-5) under this BAA.

Figure 1, Technology Development Strategy and Relationship to Planned System Development BAA for Transition



The R&D results will drive system innovation leading to a new generation of equipment capability and also the potential for retrofitting enhancements into deployed systems.

The task areas will be described in more detail below. This BAA will enable the DHS enterprise to move forward on acquiring more optimized EDS/AT solutions in terms of detection performance, throughput, size, weight, power, reliability, maintainability, procurement costs and lifecycle costs.

A single R&D organization or equipment manufacturer has not yet demonstrated the requisite knowledge, skills, experience, and manufacturing capability to successfully undertake the required technical and equipment objectives and advances of this BAA. Therefore, DHS S&T anticipates that successful responses to this BAA will include collaboration of many, multi-disciplinary research and development teams to achieve the desired end goals for S&T and TSA.

The Government anticipates that candidate team members may consist of, but are not limited to, TSA equipment manufacturers, DHS S&T sponsored-research university and industry teams, synergistic DARPA sponsored research performers, medical sector researchers and suppliers, and other third party innovators of algorithms and component manufacturers in the supply chain.

Strong multi-disciplinary teams will provide the needed fundamental and applied research results to define technologies and architectures that are transitionable by equipment manufacturers to TSA to be deployed in aviation security. Successful products from this program are also expected to find utility in a range of other Federal markets, including Federal Protective Services, the U.S. Secret Service and Customs and Border Protection.

1.8.4 Technical Areas of Interest

Central to this BAA are tasks to develop new discriminating X-ray signature approaches in robust test bed prototypes along with characterizing stream-of-commerce clutter (baggage) data collected at airports. The new improvised explosive threat signature techniques and characterized stream-of-commerce clutter will enable researchers from multi-disciplinary fields including mathematics, X-ray physics, explosive materials and chemistry, information science, and equipment developers to lay out a technical framework for significantly enhanced EDS and AT systems.

Furthermore this BAA seeks to evaluate and leverage synergistic emerging technology from other agency R&D initiatives, for example the DARPA KECoM[4] program, as applicable in order to reach BAA program goals and metrics.

[4] KECoM: Knowledge Enhanced Compressive Measurement; BAA is available here: https://www.fbo.gov/?s=opportunity&mode=form&id=02a0f656dab936171f23d7cbcbef6a22&tab=core&_cview=0

1.8.4.1 Key Technologies

Some key technical areas of interest that may assist in improving the overall detection capability are discussed below. They are at various technology readiness levels (TRLs[5]) and relate to all tasks in the BAA SOW. Offerors should consider the key technologies and their relevance to proposed work for the Task Areas; relevance should be reflected in the proposer's solutions and corresponding SOW. Key technologies are:

a) **Signatures.** The goal of obtaining chemical identification from X-ray measurements is of paramount importance. As an example, DHS S&T has high interest in problems related, but not limited to, enhanced discrimination for:

1. Objects with density near "1" in traditional CT measurement space[6], which includes many commercial and organic materials
2. Liquids and powders
3. Thin objects with large aspect ratios, e.g. thin material sheets
4. Threats and clutter via chemically-specific identification to reduce false alarms

DHS sponsored research results indicate X-ray diffraction spectra provide additional chemical identification discriminators. Other research has shown that coded-apertures may assist the discrimination, as well as techniques that provide object phase measurements. Highly accurate phase measurements may also enhance object segmentation accuracy and therefore enable improved disambiguation and object size estimates.

Sponsored research has demonstrated pencil beam and fan beam coded aperture X-ray scatter imaging along with compressive X-ray tomography that may apply to EDS and AT systems.

DHS S&T has interest in the above technologies and other potential discriminators that may provide significant reduction in the false alarm rate and enhanced threat detection in terms of reduced false alarm and probability of detection on multiple improvised explosive threat classes.

b) **Sources and detectors.** Conventional X-ray sources providing dual energy have entered the EDS equipment market. Research has been sponsored by DHS S&T and industry for new X-ray sources and detectors. Some examples are carbon nano-tube, E-beam and optically driven X-ray sources. Various types of detectors are available including energy integrating and energy discriminating or photon counting. Architecture questions remain such as the required quantity, mix of types and performance levels for EDS and AT architectures. Other devices utilized in the optical path or in signal acquisition that has a high impact on discrimination may also be of interest, for example low noise detectors.

[5] See Appendix A for TRL definitions
[6] Traditional CT measurement space near one similar to water or hydrogen peroxide

c) **Architectures.** High-impact approaches that may be suitable for retrofit into existing EDS or AT baselines as well as game-changing de-novo architectures.

Compressive measurement has been validated in several modalities with transitioned products and the fundamental mathematical theory applies across the electromagnetic spectrum. DHS S&T has ongoing sponsored research in compressive measurement and signature enhancement for X-ray systems to provide insight into trade-space questions such as the required numbers of sources, optical path(s), coded apertures, detector types and exposures to provide enhanced detection, classification including image quality for On-Screen Alarm Resolution Protocol (OSARP) given an aperture size (tunnel) and throughput speed.

Tasks on this BAA will serve to further investigate alternative architectures to obtain additional signatures by exploiting low angle coherent scattering and high angle Compton scattering simultaneously.

New architectures may benefit from consideration of novel use of sources, detectors and coded apertures utilized in an adaptive compressive measurement scheme that jointly addresses the acquisition of data or conditioning the electromagnetic field along with the desired post processing objectives. In general, initial experimental results are promising and indicate:

1. Signature separation and acquiring 3-D spatial information from a single snapshot exposure is possible
2. Less acquisition hardware (sources and detectors) may be needed to obtain the required image resolution
3. The acquisition process may be faster than in current systems
4. Chemical specificity may be improved
5. Compressive measurement may provide a path for reduced cost EDS and enhanced AT (while maintaining or improving image quality and detection specificity)

Given the significant performance/cost difference in EDS and checkpoint AT systems, it may be useful to explore a trade space of compressive measurement and coded apertures for EDS and AT; e.g. a more capable AT with a somewhat increased cost and/or a reduced cost EDS.

Compressive measurement may provide better image resolution with a shorter signal acquisition time and specificity may be improved with incoherent and coherent scatter information obtained by coded apertures, unique placement of energy sensing detectors and possibly phase signatures. The techniques may enable a convergence of EDS/AT platform architectures or common building blocks of components or modules. Scalable or modular platforms with some common modules benefit from economies of scale and may reduce lifecycle costs enabling market expansion in U.S and overseas security markets.

d) **Algorithms.** Algorithms have been developed by multiple industries such as medical, DoD, and DHS TSA-S&T for aviation security that may contribute to the goals of this BAA. DARPA has sponsored significant research in algorithmic areas indicating that task specific priors[7] may enhance detection performance. Given the large data sets from scanned checked baggage, various "big data" approaches obtaining computationally simple descriptions from complex data sets[8] may have merit for providing visualization techniques and classification improvement. Other algorithmic work along the lines of robust principal components analysis (PCA) and geometric multi-scale, learned dictionaries may provide avenues for better discrimination. The iterative reconstruction technique has shown promising results in reducing artifacts. The DHS S&T is interested in emerging and new algorithmic techniques that can be combined with new signatures measurement techniques to significantly enhance the state-of-the-art in delivered detection capability (defined as reduced Pfa with improved Pdet and while maintaining or improving throughput).

e) **Information theoretic measurement framework, informed measurement.** Generation of an information theoretic measurement framework is a central theme in this BAA in order to establish scientific rationale for cohesive research directions and priorities across task areas by establishing fundamental limits of performance and metrics for achievable goals in deployed systems retrofits and future de-novo architectures. The DHS enterprise will use the results and analysis to drive strategy, investment and priorities for aviation security technology for equipment development and test article development. Some technical references are provided in Appendix C.

X-ray scanning systems acquire (sample) the electromagnetic spectrum in order to obtain information about "objects" in the field-of-view (FOV). The threat detection and classification occurs as a post-data capture, processing activity, e.g. the electromagnetic field information impinges upon detectors that measure or sample converting analog information to digital data and subsequently algorithmic processing takes place to determine threats.

Compressive measurement mathematics and demonstrated applications suggest joint optimization of sensing or measurement and processing, e.g. jointly designing the electromagnetic sampling strategy with the signal detection/classification processing objectives, may provide significant system performance advantages.

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[7] Priors: From the DARPA KECoM program, priors may be viewed from a perspective (a) signal classes, (b) task requirements, and (c) adaptation and their incorporation into the measurement process. See Appendix B.
[8] Singh et al. Topological methods for the analysis of high dimensional data sets and 3D object recognition. Eurographics Symposium on Point-Based Graphics. Prague – September 2007.

The field of compressive measurement[9] has shown that natural systems generally may be sampled at reduced rates (less than Nyquist), capturing essential information with minimal error in reconstruction, classification and detection. For example, some experiments have shown a MSE[10] of reduction of only 3 percent with only using 1/10th of the original data.

Additionally, other research has shown adapting the measurement while the measurement process is ongoing (sampling of the electromagnetic spectrum) may reduce the total time required to acquire the information and also may improve the signal-to-noise ratio of the desired measurement.[11] Numerous approaches are under investigation by university and industry researchers, for example by performers on the KECoM program, to make informed measurement under various metrics and maximize mutual information from sampling processes for detection and classification.

The research suggests significant enhancements may be possible for X-ray screening systems. When viewing a checked bag screening system from an information theoretic perspective, numerous questions may be considered that may have significant benefit to equipment architecture and operational use.

A goal of this BAA is to define innovative measurement system architectures that jointly optimize the physical measurement system and mathematical processing framework to provide a unified or jointly designed acquisition, processing, detection, classification and reconstruction architecture or measurement system.

A measurement system proposed in response to this BAA should consider the emerging KECoM program developed technology including real-time, adaptive measurement and prior information that may optimize the joint measurement strategy based on specific tasking and also TSA's risk-based screening strategy. Joint measurement strategies including decision analytics residing in multiple sensors of differing modalities are also of interest.

Research and development performed on this BAA should answer the fundamental questions that follow:

1) Given the threat and clutter space, constrained by aperture size (equipment tunnel size) and required throughput, what is the number of unique or orthogonal signatures required to provide a significant enhancement of the ROC curves while maintaining or improving throughput?

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[9] See, for example: Baraniuk, Candes, Nowak and Vetterli "Compressive Sampling" IEEE Signal Processing Magazine, vol. 25, Issue 2 pp 12-13, March 2008. And Donoho "Compressed Sensing" IEEE Transactions on Information Theory vol. 52, No. 4, pp 1289-1306, Apr. 2006.

[10] MSE: Mean Square Error

[11] See Gehm et al. "Adaptive feature specific spectroscopy for rapid chemical identification," Opt. Express 19, 4595-4610 (2011)"

2) How much information (views or scans) is required for adequate reconstruction of objects and to provide adequate object segmentation and ultimately automatic detection and classification? Are conventional data processing approaches optimal?
3) Is it possible to provide feature specific detection and classification at enhanced Pdet and Pfa without image reconstruction and only employ object image reconstruction as an operator aid for spatial location in alarm resolution?
4) What are optimal or near optimal information measurements from a physical and mathematical implementation and how can prior information influence the actual measurement process adaptively in real-time?
5) With TSA's move to risk-based screening, can dynamically adaptive sensors and measurement processes provide operational benefit? What are the risk-based decision policies and can data be provided to inform TSA decision policies? Can other information external to the specific sensor be provided a priori to inform the measurement and detection process for improved Pdet, Pfa (such as passenger information or biometrics)? What are key priors, either external dynamic, external static information that may assist in enhanced Pdet, Pfa and/or improved screening throughput?
6) Research has progressed with active learning supporting enhanced classification in multiple applications. Can the body of research be applied to aviation security screening systems and does active learning have merit for X-ray systems given the volume of stream-of-commerce data? If so, what is the improvement and how is "system qualification or certification maintained" if active learning is employed?
7) Can other modalities and fusion be employed and effectively integrated into EDS or AT platforms at affordable cost to significantly enhance detection? If so, how are additional modalities incorporated into joint optimization of sensing?
8) Threat detection algorithms often focus on characterizing the threat with less research emphasis on clutter characterization and its reduction or removal. Is it possible to inform the measurement process of clutter objects (in situ or from a prior library) and subsequently improve the measurement process in real-time, hence reducing the clutter impact during classification processes to achieve improved Pdet, Pfa? Can clutter knowledge or characteristics be used as a prior and affect the measurement process or conditioning of the electromagnetic field to achieve a detection/false alarm benefit?

f) **Test article development.** Test articles to support this BAA and future DHS S&T DT&E need to be developed to ensure that the technologies being developed by this BAA can be adequately evaluated especially for the new signature measurement technology as described in this BAA. The test articles need to offer configurable, scalable approaches so that users are able to easily change the test items from simple, low clutter tests to the complexity of full stream-of-commerce articles.

Test article concepts and development should also support future EDS and AT vendor algorithm development and refinement at the contractor's facility in preparation for the

traditional CRT[12] testing. The motivation is a reduction of time and cost to deploy new capabilities to the DHS enterprise and the nation's airports. Typically CRT and certification testing require significant resource investment and time by vendors and DHS to achieve deployment-ready equipment. Methods and technologies enabling a reduced time and cost of equipment certification while maintaining high-quality test and evaluation standards is a goal of this BAA.

A top-level progression of planned phases, metrics and test environments are shown in Table 1. Given the state of the emerging technology, proposers are encouraged to develop and offer additional and refined metrics during the task execution as informed by performers' research and collaboration.

Item	24 months	
Period		
	Period 1	Period 2
Signature Metric	Notional example: Show distinguishable signatures with a 3x (TBD) vector distance improvement over clutter at a TBD SNR of (X)[13].	An order of magnitude improvement in signature discrimination[14]
Threat List	Measurement and identification of list in Appendix D	Measurement and identification of list in Appendix D
Complexity	Simple to moderate clutter and threats, full-sized articles.	High clutter and threat complexity. Full-sized, GFE test articles.
Test Environment	Lab	Lab and complex improvised explosive threat testing at Government site.
Comments	Show mathematical measurement framework and experimental evidence to meet metrics. Determine appropriate mathematical basis set. Measure full 3-D data cube with new signatures.	Measure full 3-D data cube with new signatures. Provide data sets to other Task Area Performers.

Table 1, Threat Clutter Discrimination Progression

[12] CRT: Certification Readiness Testing performed by a Government laboratory typically TSL and a preceding qualification step in order to enter full certification test and evaluation.
[13] Notional example shown in Table 1. Detailed signature metrics shall be developed as part of mathematical measurement framework and subject to Government approval at formal design reviews under this BAA.
[14] An order of magnitude improvement in signature discrimination from traditional effective atomic # and density measurements for selected threats, Appendix D.

1.8.4.2 DARPA KECoM Program Technology

The following narrative excerpts from the KECoM BAA introduce relevant technology to this BAA. X-ray scanner measurements are central to the detection capabilities desired in by TSA and DHS S&T. In general, because the capabilities of any sensor (e.g., sensitivity, resolution, dynamic range, etc.) are directly related to the deployed measurement resources/cost (e.g., size, weight, power, etc.), traditional sensor systems experience a tradeoff among competing performance capabilities resulting in an information bottleneck. The goal of the KECoM program is to pursue a novel unified mathematical formalism that will change the nature of measurement and thereby alleviate the measurement information bottleneck[15]. The KECoM program seeks to revolutionize the measurement process and thereby drastically improve the quantity and quality of acquired information while simultaneously reducing the cost of deployed measurement resources.

Compressive measurement focuses on making relatively few information-rich measurements, rather than many information-poor measurements; exploiting the prior knowledge that natural signals (e.g., images, chemical spectra, etc.) are nearly always sparse/compressible in some domain (e.g., wavelets, principal components, etc.). The KECoM technology will amplify the benefits of compressive measurement by incorporating into the measurement process additional prior knowledge concerning (a) signal classes, (b) task requirements, and (c) adaptation. Incorporation of signal priors can be used to ensure that measurements do not waste resources measuring something that we already know; whereas, the inclusion of task priors facilitates extraction of only that information most important to the exploitation task. Adaptation promotes an increasingly efficient measurement process, incorporating knowledge from earlier experience or measurement.

The KECoM program kick-off was in January 2011 and is a three year program. The KECoM BAA (DARPA-BAA-10-38) is referenced in Appendix B and https://www.fbo.gov/index?s=opportunity&mode=form&id=02a0f656dab936171f23d7cbcbef6a22&tab=core&_cview=0 .

[15] From DARPA KECoM goals

1.8.5 Statement of Work

The following Statement of Work (SOW) sets forth the requirements to accomplish a variety of specific activities related to enhancing X-ray detection of improvised explosive threats applicable to the DHS S&T Checked Baggage and next Generation Passenger Checkpoint programs. The identified requirements presented herein have a direct impact on meeting the requirements outlined in the Aviation and Transportation Security Act of 2001, Public Law 107-71. This project will develop enabling threat detection technology for subsequent incorporation into aviation security EDS and AT screening equipment through a planned follow-on system development program and targeted BAA.

In order to develop significantly enhanced improvised explosive threat detection solutions, the clutter from stream-of-commerce bags and improvised explosive threats must be jointly measured and characterized from new discriminating signature and information theory advances. Architectures and algorithms informed by such measurements and recent information theory innovation hold promise for new generations of equipment and the potential to retrofit deployed systems. EDS and AT equipment and specialized X-ray test bed(s) will be utilized to perform the necessary measurements and the measured signature data will be provided to performers and organizations selected by DHS S&T in support of this BAA.

To achieve the goals, the project will be composed of five major Task Areas:

1. X-ray Test Bed Prototypes. Specialized test bed prototypes incorporating new signature measurement techniques will be used to characterize stream-of-commerce clutter and improvised explosive threats. Data collected from the test bed prototype(s) will inform information theory analysis, algorithm development, and architecture development tasks.

2. Supporting Analytical Tasks. These tasks will advance information theoretic analysis of signature and clutter data to define fundamental limits and determine measurement strategies, analyze stream-of-commerce bag data sets from EDS/AT X-ray equipment, develop and test classification algorithms on the collected data sets, provide automated decision aid algorithms for TSA screening operations, and apply adaptive, compressive measurement techniques. This task will also include data collection and provide software algorithm tool kits to assist transition for TSA deployment.

3. Test & Evaluation Support. Specialized test articles/bags will be developed to support the test bed prototype and traditional EDS/AT equipment data collection and algorithm classification tests. Detection standard metrics will be established and measured on the prototype test beds and algorithms to validate the required enhancement goals using test articles.

   EDS and AT equipment from vendors will also be used for data collection to thoroughly assess technical detection challenges and provide insights to guide architecture concepts and algorithm development. EDS and AT equipment vendors

will also analyze the CRT process and offer recommendations that may reduce time and cost for deployment, while also enhancing the ability to deliver high-quality, system baseline improvements in response to new improvised explosive threats.

4. Architectural Components. Hardware component technology will be developed, such as sources and detectors that will be used to support test bed prototypes and future architecture development. This task will serve to identify key new components and also provide a head-start on potential "long-lead" items for the future system development solicitation.

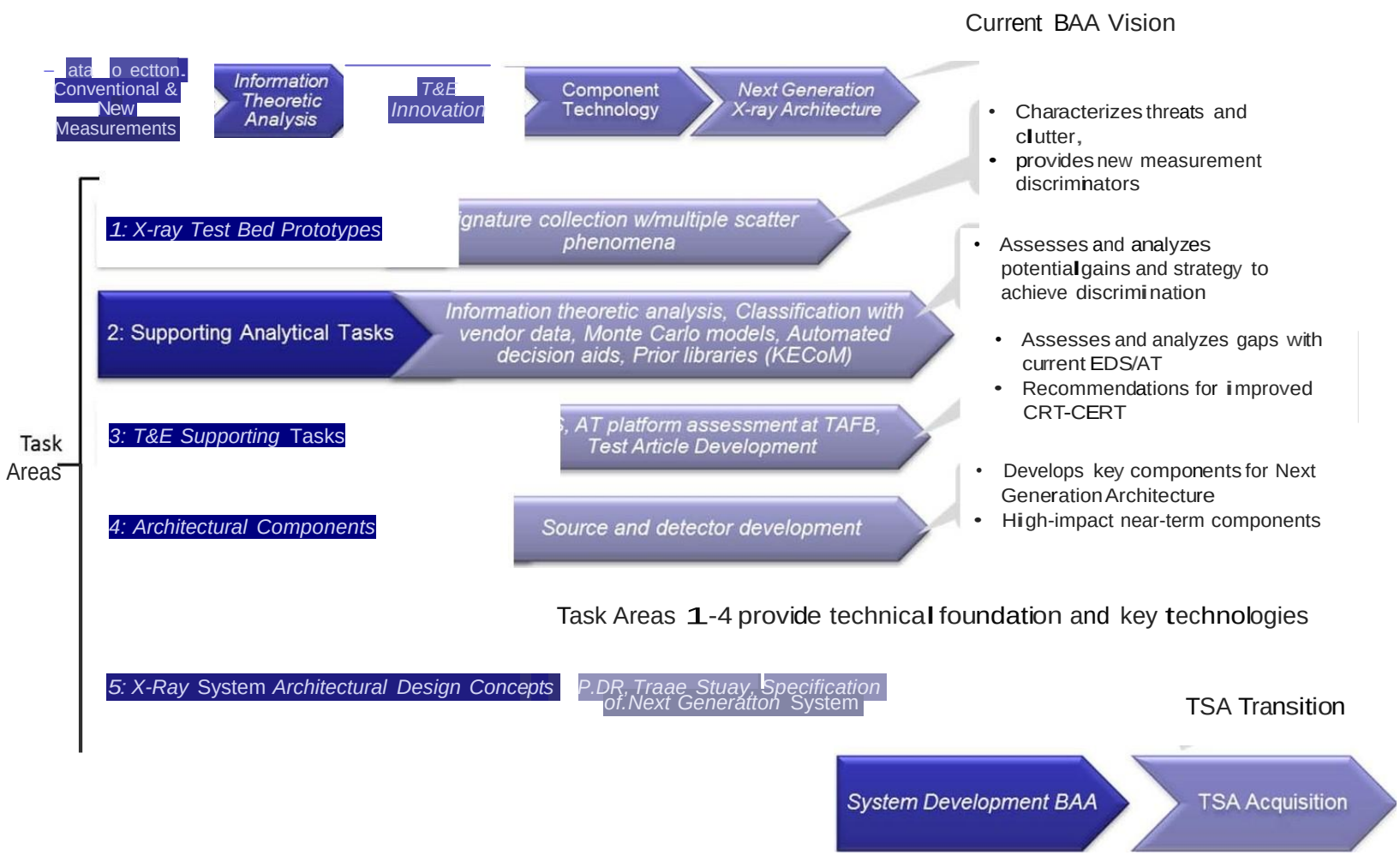
5. X-Ray System Architectural Design Concepts. This task area will lay the foundation for future system architectures by collaborating with other BAA performers, analyzing and incorporating the technology and results from other BAA tasks supported by trade-off studies and limited experimental prototyping.

   Next generation X-ray system architecture concepts will be developed meeting the stated goals and focus of this BAA to provide a viable, TSA certifiable equipment design(s). The results will be presented at a Preliminary Design Review at the end of the period of performance.

A notional summary-level task area workflow and schedule is shown in Figures 2a and 2b.

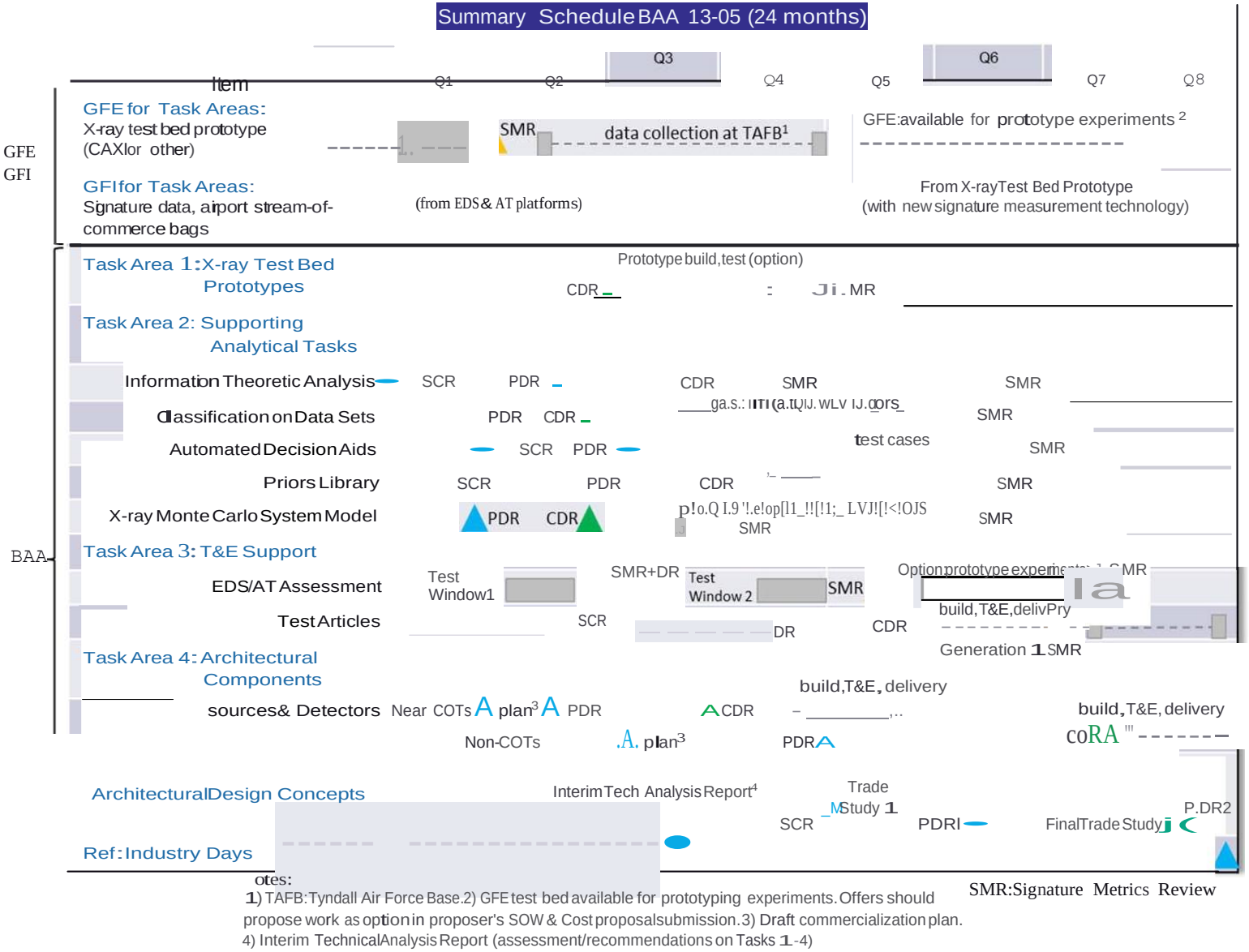
Task descriptions follow for the 5 task areas. Note that in order to avoid potential conflicts of interest, a proposer on the Test & Evaluation Support task area 3, task 3.2, Test Articles, will not be permitted to propose or participate on other tasks and proposers on other tasks may not propose or participate in task area 3, task 3.2, Test Articles.

Figure 2a, BAA Task Area Workflow and Schedule Overview



X-Ray System Architecture Transition Plan with System Development BAA

Figure 2b, Schedule Overview



otes:
1) TAFB: Tyndall Air Force Base. 2) GFE test bed available for prototyping experiments. Offers should propose work as option in proposer's SOW & Cost proposal submission. 3) Draft commercialization plan.
4) Interim Technical Analysis Report (assessment/recommendations on Tasks 1-4)

SMR: Signature Metrics Review

All tasks will have various types of formal reviews, ranging from System Concept Reviews (SCRs) to Preliminary Design Reviews (PDRs), Critical Design Reviews (CDRs) and Signature Metric and Test Reviews depending on specific BAA SOW task requirements. The following table frames the work performed and reviews should address the items enumerated and expand as appropriate.

Table 2, Key Review Items Addressing Signature Techniques Viability

#	Item	Activity and/or Parameter
1	**Validate unique signatures, orthogonal information & data**	**a)** Goal: reduction of Pfa to less than 10% for current Pdet standard **b)** Produce discrimination data on targets of interest, compare to traditional CT measurement for same threat or clutter. Use multiple signature data sources (GFI and data collected on this BAA) and relate to internal signature measurements. Demonstrate detection capability (Pdet, Pfa) and ROC curves.
2	**Characterization of macro threat properties**	**c)** Develop measurement data on target critical properties including critical diameter, max and minimum target thickness, addressing thin sheets. **d)** Demonstrate effects of targeted material containment.
3	**Characterization of non-target background**	**e)** Demonstrate rejection of clutter **f)** Include non-target and non-threat materials and artifacts inherent to measurement approach (e.g. metal objects with conventional CT)
4	**Characterization of threat target variability**	**g)** Develop signature information related to variances in target chemistry and material handling to show new method provides enhancement in detection capability
5	**Information theoretic measurement framework, real-time adaptive measurement**	**h)** Define innovative measurement system architectures that jointly optimize the physical measurement system and mathematical processing framework to provide a unified or jointly designed acquisition, processing, detection, classification and reconstruction architecture or measurement system. **i)** Generate a mathematical basis set for joint acquisition and classification. Show real-time, adaptive measurement concept. Demonstrate the use of priors[16] to improve detection capability. Quantify the benefit.
6	**Develop projected performance characteristics for candidate transitioned equipment or product**	**j)** Estimate size, weight, power, throughput, detection capability (Pdet, Pfa) and ROC curves. **k)** Provide description of sensors, source, detectors, and other critical elements along with operational constraints, safety issues.

[16] In reference to the DARPA KECoM program, a prior or library of priors should be generated from a perspective (a) signal classes, (b) task requirements, and (c) adaptation and their incorporation into the measurement and classification process.

1.8.5.1 Task Area 1: X-ray Test Bed Prototypes

Task 1.1 X-Ray Test Bed Prototype Design, Build and Test

This task will consist of two phases; a design through CDR and, at the option of DHS S&T, an option to build, test and evaluate the test bed prototype. DHS S&T is considering alternatives for a test bed prototype and will consider the merits of any proposed solution with current state-of-the-art and upon review of progress and proposed capabilities at the CDR, may choose to not exercise the build and test phase.

Task 1.1.1 Test Bed Prototype Design
Base Period: Months 1-7
A Test Bed Prototype incorporating new signature measurement techniques will be designed by the Performer. At the Government's option the Performer will build, test and integrate the test bed prototype in the Performer's facility and with a subsequent option, the Performer will support testing at a Government selected test site.

The signature measurement technology will include X-ray as a primary measurement technique. A range of non-traditional X-ray alternative technologies may also be considered with approval by DHS S&T at the system concept review. Alternative technologies may also be proposed but the commercialization and cost must be considered. The design of the test bed will consider the enhanced discrimination of improvised explosive threats and stream-of-commerce clutter as the primary goal. The design shall include and consider compressive measurement and adaptive compressive measurement as appropriate and other techniques to provide enhanced discrimination, higher screening throughput and reduced lifecycle costs.

The test bed prototype is not intended to transition to a product but the measurement approach must be commercially viable for use in other systems. The test bed prototype must provide a robust experimental measurement tool to collect signature data, verify notional architecture elements in the optical path and acquisition channel. Extensive signature data will be collected and provided to other DHS S&T selected performers. The experimental data and signature data will be used to inform EDS and AT architectural development activities along with new detection and classification algorithm development.

The test bed prototype will have the capability to measure and characterize full-sized stream-of-commerce checked baggage in accordance with relevant TSA standards for EDS. The test bed prototype will be used to collect the equivalent of full 3-D CT data fully characterizing objects to include clutter and improvised explosive threat materials in the tunnel.

The test bed will permit other types of measurement with insertion of additional devices in the optical path as well as multiple source types, multiple detector types and multiple placements for sources and detectors. For example, the test bed prototype will incorporate additional signature measurement techniques such as, but not limited to, coded apertures,

phase measurements and various types of X-ray scatter phenomena (coherent and non-coherent).

The test bed prototype will incorporate a variety of sources and detectors, varied placement and types of detectors to assist architectural trade-offs and trade-space analysis to guide optimized architectures for EDS and AT equipment. The design shall be modular and support a third party placement of devices in the optical path after the test bed is built. Mechanical drawings and interface control drawings will be generated to sufficient accuracy and quality to permit third party design teams to design devices and place devices in the test bed.

The test bed will have the ability to take measurements on the full-volumetric (geometric) data cube of the baggage under test and fully characterize stream-of-commerce clutter and improvised explosive threat materials in a 3-D data cube at a minimum measured isotropic resolution of 0.5 mm. Alternative resolutions may be considered at PDR subject to Government approval.

The collected or sampled data will be transferred in raw format from the focal planes and detectors for off-line data processing. The test bed will interface to an IT system of sufficient capacity and speed to provide hard disk drive media for distribution of the collected data. Industry standard interfaces will be used in transferring the data to the IT system and disk drive to maximize the interoperability and ease of use for the anticipated users of the collected data.

All pertinent collected meta-data will be appended to the raw data collected from the test bed to permit, simulated (off-line) re-scan or simulated acquisition off-line. The collected raw data will be used for a variety of tradeoff and analysis related tasks such as information theory analysis, algorithm development and system architecture and component analysis. Additionally the data may be used for more conventional preprocessing, reconstruction, segmentation and classification.

The Performer will design a test bed prototype in this baseline task. The baseline task will culminate in a CDR and documentation as noted in the following section. The Performer will perform various analysis, modeling, simulation, experimental measurements and trade studies as part of the test bed design activity. The Performer will generate a specification of the test bed prototype for review at CDR. Based on the specification and state-of-the art in X-ray measurement systems, the Government may exercise the option to build and test the prototype.

Optional Task 1.1.2 Test Bed Prototype Build and Test (Optional task, exercised at DHS S&T's discretion)
<u>Optional Task Period: Months 7-13</u>

The Performer will build, test and demonstrate the Test Bed prototype at the Performer's lab. Testing will include both non-clutter and clutter measurements. Tests will be performed based on a written and approved test plan provided by the Performer. A test plan will be prepared and submitted to DHS S&T Explosives Division prior to conducting final experimental measurements. The test plan will outline the materials, objects, test patterns and scenarios to be evaluated (estimated to be about 125 types), along with measurement equipment, processes and procedures. The testing will progress from simple signature tests to complex signature testing with stream-of-commerce clutter and explosive analogs or simulants. The Performer will prepare test articles per the approved Test Plan. Additionally DHS S&T will provide test articles in test bags per Table 12 (page 53), and a list of compounds for testing. The list of compounds will be less than 125 items.

This task will culminate with a review of the experimental measurement results and analysis in a Signature and Performance Metrics Review. The Performer will hold a Signature and Performance Metrics Review as a critical performance milestone near the end of the Performer's lab/facility testing and also at the end of the Government Lab testing. The first Signature and Performance Metric Review will be held by month 14 (a proposer may provide an earlier or later date with rationale). The reviews will include statistical analysis of system performance in terms of specificity of multiple improvised explosive threat classes (via surrogates), sensitivity and discrimination in terms of Receiver Operating Characteristic (ROC) curves as well as real-time demonstrations confirming system metric and discrimination goals. A full-architecture, test bed review, as built and tested, will also be presented along with suggested future modifications if applicable.

The Performer will provide signature data collection from the test bed per the test plan. The collected data will be provided to DHS S&T for distribution to DHS S&T selected third parties.

Formal data collection will begin one month or sooner before the Signature and Metrics Review. Distribution of the collected data will be via shipping hard disk drive media; two copies will be shipped to a DHS S&T specified location *(assume Washington, DC for the cost proposal).* Electronic data records will accompany the hard drives including metadata to describe the relevant collection details in order to enable post processing through reconstruction to occur by third party organizations. The drives with the raw data content will also include the metadata. As data is collected on the test bed, the Performer will ensure adequate transfer bandwidths, buffering such that all data from the focal plane during a bag scan is acquired and stored on the hard drive. The Performer will provide an interface control document describing the raw data, metadata formats and a CONOP outlining the use of the collected data in a third-party computer-based application to facilitate analytical use of the collected data.

The Performer will provide adequate archive storage for formal data collection until acknowledgement by DHS S&T that the shipped disk drive integrity has been verified. The Performer's IT system, external to the test bed and including storage system and media costs, will be segregated in the cost proposal.

This task will determine the feasibility and specifications for a subsequent system development transition to commercial vendor EDS/AT equipment and TSA. The concept will be presented at the Final Metrics and Performance review and should correspond to a Preliminary Design Review (PDR) level for a certifiable platform.

For purposes of proceeding to DT&E, an abbreviated Vendor Data Package will be prepared that indicates a safety analysis has been performed through testing or analysis, that the test bed prototype is likely to meet technology-appropriate safety regulations and not present safety hazard at the Government selected test site. Examples of such regulations are: Underwriters Laboratories (UL), Conformité Européne (CE) and Occupational Safety and Health Administration (OSHA) safety standards and Federal Communications Commission (FCC) Part 15 for all systems; FCC Part 90 for systems using RF energy; 21CFR1020.40 for cabinet X-Ray systems; and 29 CFR 1926.54 for systems using lasers. Actual certification of the test bed is not required.

Optional Task 1.1.3 Second Test Bed Fabrication, Test and Delivery (Optional task, to be exercised at DHS S&T's discretion)
Optional Task Period: Months 13-24

Task 1.1.3 efforts include the fabrication, testing, and delivery of a second test bed prototype (copy) upon passing the Go/No Go metrics review at the Performer's facility. The test bed prototype will be placed under configuration management at the beginning of the option period; no later than 30 days after the beginning of the option period. A system documentation review will be held with DHS S&T within 30 days of option exercise.

The test bed copy will be fabricated, tested and shipped to a Government specified test facility. The test site will be chosen by DHS S&T and the supporting T&E work performed by a test organization. The test organization activities will be covered in a separate Interagency Agreement (IAA) by DHS S&T. The test site is assumed to be Tyndall AFB, Panama City, FL, but subject to change at the discretion of the Government.

Signature discrimination performance will be validated with a second set of DHS S&T test articles and materials at the DHS S&T selected site. The Performer will provide three months onsite support for test bed unpacking, installation, initial operational checkout and operational test support. The Performer will pay shipping costs.

Documentation, demonstrations and reviews
Base Period: Months 1-7 (and Optional Task 1.1.2 and Optional Task 1.1.3)

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing.

The Performer will hold a System Concept Review, PDR, CDR, Interim and Final Signature and Performance Metrics Review and Demonstration. PDR and CDR guidelines are in Appendix E and can be tailored based on applicability.

The **Signature and Performance Metrics Review and Demonstration** is a critical Task Go/No Go milestone. The review will include statistical analysis of system performance and molecular signature discrimination as well as real-time demonstrations confirming overall system sensitivity, signal-to-noise and discrimination goals.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will provide the test bed collected signature data to DHS S&T and another facility for storage and distribution to other third parties that DHS S&T may specify.

The Performer will generate and deliver a System Design Document covering all tasks which will include (but is not limited to) the physical designs, optical system designs, hardware, parts lists and bill-of-materials, system interfaces, software architecture and design (including source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment. The system design document will include a test bed operations manual to assist third party use of the test bed for signature testing and data collection.

The Performer will provide an interface control document (ICD) describing the data, metadata formats and a CONOP document on how to interface with and use the collected data in a computer-based application to facilitate third party, analytical use of the collected data. The CONOP and ICD will also provide information on proper interfacing between the test bed and an IT system in general, other than the Performer's IT system.

Major Milestones and Deliverables Summaries are shown in the following tables.

Table 3, Major Milestones and Deliverables Summary, Test Bed Prototype Design
Task 1.1.1 Base Period: Months 1-7

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	1
2	System Concept Review	1
3	PDR	3
4	CDR	6
5	Specifications	6
6	System Design Document	6
7	CONOP	6
8	Interface Control Document	6
9	Annual Technical Report	7
10	Monthly Status Report	Monthly
11	Quarterly Status Review	Quarterly
12	Meeting Minutes	Note 1
13	Presentations	Note 2

Table 4, Major Milestones and Deliverables Summary, Test Bed Prototype Build and Test (Optional Task 1.1.2, exercised at DHS S&T's discretion)
Optional Task 1.1.2 Period: Months 7-13

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	7
2	Test Plan	7
3	Test Bed Demonstration	10
4	Signature, Metrics Review & Demonstration	12
5	Test bed signature data (for distribution)	13
6	Test Report	13
7	System Design Document	13
8	CONOP	13
9	Interface Control Document	13
10	Annual Technical Report	13
11	Monthly Status Report	Monthly
12	Quarterly Status Review	Quarterly
13	Meeting Minutes	Note 1
14	Presentations	Note 2

Table 5, Major Milestones and Deliverables Summary, Second Test Bed Fabrication, Test and Delivery (Optional Task 1.1.3, to be exercised at DHS S&T's discretion)

Option Task 1.1.3 Period: Months 13-24

Item	Milestone and Deliverable	Date (Months ACA)
1	Test Bed Prototype (delivery of copy)	15
2	Data Collection at Government at Selected Site	16-23
3	Test bed signature data (for distribution)	17-24
4	Test Report	24
5	Final Signature & Metrics Review	24

The anticipated period of performance (PoP) is 7 months base period with an optional task 1.1.2 period of performance of months 7-13 and an optional task 1.1.3 period of performance of months 13-24. Given the nature of this work and importance to the DHS S&T mission, proposed schedules for shorter periods of performance are encouraged with supporting rationale, although not at the expense of accomplishing the program and task objectives. The proposer may present long-lead items for optional tasks 1.1.2 and 1.1.3 at the base period PDR or CDR. DHS S&T may exercise the respective option to procure the long-lead item(s). Long-lead item proposed costs should be segregated in respective optional task cost proposal.

The PoP will include a Government evaluation of technical reports, PDR, CDR, test plans and other design documentation. This effort will conclude with a Final Metrics and Performance review with delivery of the system provided by the Contractor(s). The Performer will provide 3-days of training on the test bed along with a training manual.

The Government reserves the right to witness all Contractor-conducted test activities. The Contractor(s) shall provide the Government at least one week written notice prior to conducting the tests.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.
Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

1.8.5.2 Task Area 2: Supporting Analytical Tasks

These tasks will advance information theoretic analysis of X-ray signature and clutter data, analyze GFI collected stream-of-commerce bag data at airports using EDS/AT equipment, develop and test classification algorithms on the collected data sets, provide automated decision aid algorithms for TSA screening operations and apply adaptive, compressive measurement techniques to EDS and AT architectural concepts. Offerors may propose on any or all of the following tasks.

Task 2.1, Information theoretic analysis
Base Period: Months 1-18

The Performer will provide an information theoretic analysis of the EDS and AT system data acquisition and classification approaches to determine the optimum or near optimally minimum required number and/or types of signatures to achieve specified detection performance in terms of ROC curves and based on improvised explosive threat classes and clutter. DHS S&T will provide analogues lists with similar characteristics to improvised explosive threat classes and at the Government option may provide actual improvised explosive threat chemical compounds and characteristics. The Government will provide representative data sets from airport stream-of-commerce equipment, EDS/AT equipment, test bed prototypes and other sources. The data sets will include raw data including meta-data. The data sets may be on the order of 100 terabytes. Interface and format specifications will be provided at the post-award kick-off meeting.

Traditional EDS-CT utilizes two basic discriminating signatures; effective atomic number and density of screened objects along with an object-image structural information vector. The Performer's analysis will consider supplementing the traditional approach with new signature measurements as well as methods to increase clutter discrimination.

The analysis will utilize collected data sets (GFI) from airport EDS and AT equipment as well as the test bed signature data sets (GFI) in support of this analysis. The analysis should consider the improvised explosive threat classes and new additional signature measurement techniques such as, but not limited to, various types of X-ray scatter phenomena (coherent and non-coherent), coded apertures and phase measurements. The analysis should recommend additional signatures for threats and clutter, the numbers and types of detectors, trade-offs in compressive measurement approaches, define classification approaches and evaluate ROC curve performance in the trade space. Based on stream-of-commerce clutter, the analysis should in a statistical sense, predict the number and types of signatures or other discriminates necessary to achieve specific performance points on a ROC curve parameterized to the improvised explosive threat classes individually and as a whole set across the traditional "effective atomic number" and "density" coordinate axes.

The Performer will develop the mathematical models and simulations and test them against Performer-generated test vectors as well as collected data (GFI). DHS S&T will provide feedback on performance against EDS and AT performance standards and metrics. The mathematical models and simulations will be incorporated into a measurement strategy by

the Performer to guide architectural development efforts by other performers selected by DHS S&T on other tasks in this BAA.

The task output and final report should provide recommendations on system architecture(s), signature discriminators along with the number of necessary mathematical discriminators in regions of interest related to the improvised explosive threat list in consideration of the stream-of-commerce clutter objects. The final analysis and report should provide an estimate of the fundamental limits of detection performance with respect to the signatures, stream of commerce clutter and ROC curves. The analysis and report should provide a measurement strategy for equipment and roadmap for future enhancements. The analysis and report should include future areas of system design and architecture definition for X-ray screening systems applicable to checked baggage and checkpoint (EDS and AT equipment) as well as short-term recommendations to deployed EDS and AT systems. The analytical model and algorithms will be demonstrated and a final Test Review will be held.

Upon passing test and evaluation scenarios and metrics, the algorithms and software will be developed and refined to an adequate maturity level and incorporated into a software tool kit deliverable that can be made available to third parties (for example equipment developers) to support transition to TSA. The tool kit will include, but is not limited to, algorithms, software, libraries, code, runtime environment definition, CONOP, interface definitions and software design documentation to facilitate easy use by third parties.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to final testing.

The Performer will hold a System Concept Review, PDR and CDR. The Performer will hold **Interim and Final Signature and Performance Metrics Reviews and Demonstrations.** The review will include statistical analyses of system performance and signature discrimination as well as real-time demonstrations confirming discrimination goals.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will present a project overview, scientific theory, experimental methods and results at two industry days per year in Washington, DC. Each industry day event will require attendance by the PI and key staff. Each industry day event duration is two days.

The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but are not limited to) the physical designs, optical system designs, hardware, parts lists, software (source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment.

Major Milestones and Deliverables Summary are shown in the following table.

Table 6, Major Milestones and Deliverables Summary, Task 2.1, Information Theoretic Analysis
Base Period: Months 1-18

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	<1
2	System Concept Review	1
3	Collection Plan Review (for airport collection)	2
4	PDR	5
5	Test plan submission	8
6	CDR	8
7	Interim Signature & Metrics Review	12
8	Final Signature & Metrics Review	18
9	Test Report	18
10	System Design Document	18
11	CONOP	18
12	Interface Control Document	18
13	Final Technical Report	18
14	Software Tool Kit	18
15	Monthly Status Report	Monthly
16	Quarterly Status Review	Quarterly
17	Meeting Minutes	Note 1
18	Presentations	Note 2

The PoP is up to 18 months. The Government may consider shorter or longer periods of performance with adequate supporting rationale.

The PoP will include Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the Software Tool Kit and the final design document provided by the Performer(s) to the Government.

The Government reserves the right to witness all Performer-conducted test activities. The Performer shall provide the Government at least one week written notice prior to conducting testing.

Task 2.2, Classification on Vendor Data Sets
Base Period: Months 1-15

EDS and AT equipment along with other advanced sensors employing compressive, adaptive, scatter imaging measurements may benefit from application of advanced inference and classification techniques to improve detection capability in terms of a false alarm reduction, improved probability of detection and decision analytics for Transportation Security Officers (TSOs).

In Phase 1, the Performer will develop advanced inference and classifications concepts and algorithms applicable to current X-ray EDS and AT equipment to improve detection capability in terms of false alarm reduction and improved probability of detection for multiple improvised explosive threat classes and object types. The Performer will utilize lessons learned from cooperative classification projects with vendors and apply them to enhance future EDS and AT architectures in Phase 2.

The algorithms to be developed by The Performer may reside in several broad classes, including, but not limited to: non-linear kernel-based supervised classifiers, semi-supervised classifiers, active learning, concept drift, sensor management/multi-view, risk minimization, and high-dimensional topological data analysis.

The Performer will review techniques and select a baseline approach or approaches. The Performer will present the results along with the rationale at a System Concept Review and at appropriate intervals provide design progress updates at PDRs, CDRs and Test Reviews as the task progresses.

In Phase 1, (part one of this task), the Performer will use real data from vendor EDS or AT equipment as solicited and approved by DHS S&T. The Performer will utilize real equipment data sets to demonstrate and verify the inference and classification methods. DHS S&T will provide a FedBizOps solicitation notice for potential participants/vendors to submit White Papers of interest for collaboration on this task. The vendor collaboration solicitation will be made by DHS S&T within 30 days of the post award kick-off from contract award on this task. See Appendix F for an example solicitation.

The Government will review and evaluate the White Paper responses from the solicitation of the candidate proposers for collaboration on this task. Upon selection of the White Paper offerors (EDS and AT vendors), engagement will be made with the Performer and vendor(s) for collaboration initiation. The Performer and vendor will use a best effort to reach agreement on the interface and sign mutual non-disclosure agreements as appropriate. The vendor collaborator(s) are anticipated to provide data sets to the Performer on this task. The Performer on this task will utilize the vendor data sets in performing the work on this task.

For cost proposal purposes, the Performer should plan on one trip to each of an estimated eight vendor sites resulting from the post-award solicitation, vendor engagement; four in the Boston, Massachusetts area and four in the San Jose, California area. The Performer will also accommodate up to eight vendors each, separately, for a 2-day overview on the Performer's algorithmic approach for the classification method introduction and to establish proper interfaces to receive the data sets. The Performer will host individual 2-day overviews at the Performer's facility for each participant/vendor selected from the future DHS S&T solicitation (and corresponding DHS S&T White Paper evaluation).

The Performer will develop the mathematical models and simulations and test them against collected data (GFI) and known EDS and AT performance (provided by DHS S&T and the vendor).

The Performer will hold a System Concept Review, PDR and CDR. The analytical model will be demonstrated and a final Test Review will be held for each vendor.

The subsequent classification results by the Performer will be provided to the respective vendors and upon approval from DHS S&T be presented at an industry day. Results of individual collaborators or any proprietary data will not be disclosed, but presented in a sanitized format.

Upon passing test and evaluation scenarios and metrics, the algorithms will be developed and refined to an adequate TRL level (five or six) and incorporated into a software tool kit deliverable that can be made available to third parties (for example equipment developers) to support transition to TSA. The tool kit will include, but is not limited to, algorithms, software, libraries, code, runtime environment definition, CONOP, interface definitions and software design documentation to facilitate easy use by third parties.

In Phase 2, the Performer will apply lessons learned from Phase 1 and GFI received from other tasks to develop techniques for the next generation systems.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing.

The Performer will hold a System Concept Review, PDR and CDR. The Performer will hold a **Performance Metrics Review and Demonstration** with each data set provided and evaluated. The reviews will include statistical analysis of system performance in terms of specificity of improvised explosive threat classes, sensitivity and discrimination in terms of Receiver Operating Characteristic (ROC) curves.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will deliver the software algorithm tool kit with their CONOP and interface control document to enable third party users to incorporate the tool kit for their own purposes in transitioning EDS and AT systems to TSA.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but is not limited to) the physical designs, optical system designs, hardware, parts lists, software (source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment.

Major milestones and deliverables are summarized in the following table.

Table 7, Major Milestones and Deliverables Summary, Task 2.2, Classification on Vendor Data Sets
Base Period: Months 1-15

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule, SCR	<1
2	PDR	2
3	CDR	5
4	Test plan submission	5
5	Classification test cases begin	7
6	Interim Classification & Metrics Review	10
7	Classification test cases end	14
8	Final Classification & Metrics Review	15
9	System Design Document	15
10	S/W Tool Kit	15
11	CONOP & ICD	15
12	Final Technical Report	15
13	Test Report	15
14	Monthly Status Report	Monthly
15	Quarterly Status Review	Quarterly
16	Meeting Minutes	Note 1
17	Presentations	Note 2

The anticipated period of performance is up to 15 months. The Government may consider shorter or longer periods of performance with adequate supporting rationale.

The PoP will include a Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the Software Algorithm Tool Kit and the final design document provided by the Performer(s) to the Government. The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations

The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes

The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

Task 2.3, Automated Decision Aids
Base Period: Months 1-17

Automatic threat detection and operator decision aids to support TSO human factors and cognition aspects will be developed, and demonstrated. The Performer will survey and develop advanced, automated machine learning algorithms to separate potential threat objects from clutter in stream-of-commerce articles in checkpoint carry-on items and checked baggage and alert the TSO.

Two-operational modes will be analyzed: 1) current EDS and AT systems as deployed to achieve retrofit baseline improvement and 2) future architectures that will incorporate adaptive sensing in the context of standalone EDS/AT systems and networked EDS/AT systems with other sensors incorporating use of priors and risk-based screening policy. The algorithmic architecture will include the analysis of, but not limited to, POMDP (Partially Observable Markov Decision Process) and KECoM priors and their integration into the automatic decision aids baseline. Alternatives other than POMDP and KECoM priors are acceptable with rationale to meet the DHS enterprise goals.

The algorithmic architecture concepts will be developed and demonstrated in a simulation model to guide the appropriate algorithm trade-offs and final baseline selection. Multiple test scenarios will be run in the simulated environment and demonstrated with a performance assessment in terms of but not limited to, ROC curve performance, adaptability, use of priors and techniques supporting risk-based screening, feasibility for implementation in current EDS and AT baselines as well as future architectures. The Performer will develop a war gaming simulation platform and test vectors. Additionally GFI and data will be provided representing EDS and AT systems supporting additional war gaming scenarios.

The Performer will incorporate input from DHS S&T and TSA to model external detection policy, particularly risk-based screening. The Performer will hold quarterly progress reviews and perform testing to validate performance metrics achieved under various scenarios. The Performer will provide a test plan for approval by DHS S&T and support red-teaming by DHS on the simulation platform. The Performer will provide support for six technical interchange meetings (TIMs) in Washington, DC with DHS S&T and TSA to discuss and determine appropriate policy decisions inputs to the model. These TIMs are in addition to other design reviews.

Upon passing test and evaluation scenarios and metrics, the algorithms will be developed and refined to an adequate maturity level and incorporated into a software tool kit deliverable that can be made available to third parties (for example equipment developers) to support transition to TSA. The tool kit will include, but is not limited to, algorithms, software, libraries, code, runtime environment definition, CONOP, interface definitions and software design documentation to facilitate easy use by third parties.

Government Site Test and Evaluation (Option). Upon adequate performance with Performer test vectors and GFI and at the Government's discretion, a test and evaluation

option may be exercised for additional testing at a Government selected test site *(assume TSL for the cost proposal).* The Performer will support onsite testing of one month to include installation, initial checkout and support of test and evaluation. Offerors are to provide a separate cost proposal for this optional task.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing.

The Performer will hold a System Concept Review, PDR and CDR. The Performer will hold a **Performance Metrics Review and Demonstration** with each data set provided and evaluated. The reviews will include statistical analysis of system performance in terms of automatic object discrimination in terms of Receiver Operating Characteristic (ROC) curves.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will present a project overview, scientific theory, experimental methods and results at two industry days per year in Washington, DC. Each industry day event will require attendance by the PI and key staff. Each industry day event duration is two days.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but is not limited to) IT system design, COTS software, software developed (source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment.

Major milestones and deliverables are summarized in the following table.

Table 8, Major Milestones and Deliverables Summary, Task 2.3, Automated Decision Aids
Base Period: Months 1-17

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	<1
2	Project Schedule	<1
3	System Concept Review	3
4	PDR	6
5	CDR	9
6	Test Plan	9
7	Classification test cases begin	11
8	Interim Classification & Metrics Review	13
9	Government Site T&E (Option)	15
10	Performance Metrics Review	17
11	Test Report	12
12	S/W Tool Kit	17
13	CONOP & ICD	17
11	System Design Document	17
12	Technical Interchange Meetings (Red Team Support)	Quarterly
13	Monthly Status Reports	Monthly
14	Quarterly Status Review	Quarterly
15	Meeting Minutes	Note 1
16	Presentations	Note 2
17	Annual Technical Report	Annually

The anticipated period of performance is up to 17 months. The Government may consider shorter or longer periods of performance with adequate supporting rationale.

The PoP will include a Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the Software Algorithm Tool Kit and the final design document provided by the Performer(s) to the Government. The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

Task 2.4, Priors Library
<u>Base Period: Months 1-18</u>

Priors Library Development
The Performer will investigate compressive measurement techniques applicable to EDS and AT systems in the context of KECoM priors[17]. Compressive measurement focuses on making relatively few information-rich measurements, rather than many information-poor measurements; exploiting the prior knowledge that natural signals (e.g., images, chemical spectra, etc.) are nearly always sparse/compressible in some domain (e.g., wavelets, principal components, etc.).

In development of priors, the Performer will investigate and evaluate the X-ray modalities used in EDS and AT equipment; GFI collected data sets from the equipment along with test beds incorporating new emerging signatures techniques. Emerging signatures are to include new additional signature measurement techniques such as, but not limited to, various types of X-ray scatter phenomena (coherent and non-coherent), coded apertures and phase measurements. Other items to consider are: 1) optical path architectures including innovative sources and detectors, numbers and types of sources and detectors and 2) traditional EDS-CT utilizing two basic discriminating signatures; effective atomic number and density of screened objects complimented with an object-image structural information vector for classification.

The Performer will develop mathematical approaches for incorporation of priors to provide enhanced detection capability in terms of performance (improved ROC curves), throughput and reduction of physical resources and possible system cost reduction. The results of the analysis will be in a comprehensive trade-off study based on mathematical rigor, simulation and modeling and to the extent possible validated with the GFI data sets.

The Performer should recommend a library of priors based on the detection modalities, improvised explosive threats and stream-of-commerce clutter and other postulated or notional information that may be available (or should be made available by the Government with a convincing rationale). The prior library should be generated from a perspective (a) signal classes, (b) task requirements, and (c) adaptation and their incorporation into the measurement process. The operational benefit resulting from the three classes of prior libraries shall be analyzed and predicted in terms of detection capability (ROC curves) and enhanced throughput. The developed prior library, at the option of DHS S&T, will be tested and evaluated in an X-ray scanner test bed, prototype or vendor system to verify improvements from application of priors.

The Performer will also analyze and recommend approaches and strategies for dynamic, real-time adaptive sensing in the context of the aviation security screening systems beyond the EDS and AT system, extending to other security layers including, but not limited to, sensors or detection equipment (AIT checkpoint portals for example), biometrics and other

[17] Priors: From the DARPA KECoM program, priors should be generated or defined from a perspective (a) signal classes, (b) task requirements, and (c) adaptation and their incorporation into the measurement process.

external notional or postulated vectors to assist in enhanced classification of threat or no threat. The Performer's recommendations will address incorporation into EDS and AT baselines for both short-term retrofit and development of future EDS and AT architectures.

Upon passing test and evaluation scenarios and metrics, the priors library and any algorithms will be developed and refined to an adequate maturity level and incorporated into a software tool kit deliverable that can be made available to third parties (for example equipment developers) to support transition to TSA. The tool kit will include, but is not limited to, algorithms, software, libraries, code, runtime environment definition, CONOP, interface definitions and software design documentation to facilitate easy use by third parties.

Government Site Test and Evaluation (Option). Upon adequate performance with Performer test vectors and GFI and at the Government's discretion, a test and evaluation option may be exercised for additional testing at a Government selected test site *(assume TSL for the cost proposal).* The Performer will support onsite testing of one month to include installation, initial checkout and support of test and evaluation. Offerors are to provide a separate cost proposal for this optional task.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing.

The Performer will hold a System Concept Review, PDR and CDR. The Performer will hold **Interim and Final Signature and Performance Metrics Reviews and Demonstrations.** The reviews will include statistical analysis of system performance in terms of improved detection capability: specificity of improvised explosive threat classes, sensitivity, classification, classification speed and discrimination in terms of Receiver Operating Characteristic (ROC) curves.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will present a project overview, scientific theory, experimental methods and results at two industry days per year in Washington, DC. Each industry day event will require attendance by the PI and key staff. Each industry day event duration is two days.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but is not limited to) IT systems used, COTS software, software developed (source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment. Major milestones and deliverables are summarized in the following table.

Table 9, Major Milestones and Deliverables Summary, Task 2.4, Priors Library
Base Period: Months 1-18

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	<1
2	System Concept Review	3
3	GFI- Test Data Provided	3
4	PDR	6
5	CDR	9
5	Test Plan	9
6	Test cases begin	10
7	Interim Signatures and Performance Metrics Review	12
8	Government Site T&E (Option)	13
9	System Design Document	18
10	Final Signatures and Performance Metrics Review	16
11	S/W Tool Kit with Interface documentation	18
12	CONOP	18
13	Interface Control Document	18
14	Annual Technical Report	12, 18
15	Test Report	18
16	Monthly Status Report	18
17	Quarterly Status Review	Quarterly
18	Meeting Minutes	Note 1
19	Presentations	Note 2

The anticipated period of performance is up to 18 months for this task area. The Government may consider shorter or longer periods of performance with adequate supporting rationale.

The PoP will include a Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the Software Tool Kit and the final design document provided by the Performer(s) to the Government.

The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

Task 2.5 Monte Carlo Model for X-ray Systems
Base Period: Months 1-15

The Performer will develop a software model(s) to support architecture development for next generation EDS/AT systems. The model may also assist equipment developers in modification of current baseline systems for near-term capability enhancement.

The main focus of the model (which could include a Monte Carlo driven model) is to provide adequate fidelity for X-ray optical system design from source components through detector array. Model parameterization should support various aperture types including coded apertures and a small, limited set of objects placed in the beam path enabling estimation of signal-to-noise at the detector under various scenarios representative of X-ray scatter phenomena. Parameterization should include but is not limited to source characteristics, source spectrum, FOV, beam type, object placement and detector characteristics including spectral response. As a minimum, the model should support TSA standards for tunnel sizes. The model will provide a graphical user interface to facilitate model parameter changes in support of analytical and engineering trade-offs. In development of the model and software, commercial standards will be utilized to the extent possible for software applications and interfaces.

The performer will hold a system concept review that will provide the model technical concept and approach as well as specifications of the model and envisioned computer operating environment. During the progression of the task, the performer will hold a SCR, PDR and CDR and provide a test plan (for approval by DHS S&T). Testing will be used to validate the model's robustness and fidelity for the intended applications. The test plan will address validation in the simulated environment as well as validation with X-ray equipment.

In Phase 1, (part one of this task), the Performer will develop and test the model in a simulated environment. In Phase 2 of this task, the Performer will parameterize the software model to represent vendor EDS or AT equipment, evaluate and adjust the model

as appropriate to obtain reasonable fidelity with respect to the specific EDS and/or AT equipment with scanned test articles and materials.

In order to gain access to EDS or AT equipment baselines and vendor expertise in support of this task, DHS S&T will provide a FedBizOps solicitation notice for potential participants/vendors to submit White Papers of interest for collaboration with the Performer. The vendor collaboration solicitation will be made by DHS S&T within 30 days of the post award kick-off from contract award on this task, analogous to an example solicitation used for a cooperative classification activity shown in Appendix F, which will be modified appropriately reflecting the scope of this optional modeling task.

The Government will review and evaluate the White Paper responses from the solicitation of the candidate proposers for collaboration on this task. Upon selection of the White Paper offerors (qualified platform vendors such as EDS and AT equipment manufacturers), engagement will be made with the Performer and vendor(s) for collaboration initiation. The Performer and vendor will use a best effort to reach agreement on the work plan, interfaces and sign mutual non-disclosure agreements as appropriate. The vendor collaborator(s) are anticipated to provide data to the Performer on this task in order to assist the Performer in development of the model architecture and features. The Performer on this task will utilize the vendor provided data in performing the model development.

The Performer will host individual 1-day overviews at the Performer's facility for each participant/vendor selected from the future DHS S&T solicitation (and corresponding DHS S&T White Paper evaluation). The Performer will accommodate up to six vendors each, separately, for the 1-day overviews to cover the Performer's model architecture approach, to understand any unique vendor goals and requirements and to establish proper methods to exchange information on the task.

The Performer will test the model against GFE test materials and GFE test articles. The Performer will also compare the model results with the respective vendors' equipment using scanned GFE test materials and GFE test articles. The results will be provided in a test report.

The subsequent test results by the Performer will be provided to the respective vendors and upon approval from DHS S&T be presented at an industry day. Results of individual collaborators will not be disclosed or any proprietary data from participants, but presented in a sanitized format.

Upon passing test and evaluation scenarios and metrics, the model will be developed and refined to an adequate TRL level (five or six) and incorporated into a software tool kit deliverable that can be made available to third parties (for example equipment developers). The tool kit will include, but is not limited to, algorithms, software, libraries, code, runtime environment definition, CONOP, interface definitions and software design documentation to facilitate easy use by third parties.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing. The model will be demonstrated and a final Test Review will be held for each vendor collaboration.

The Performer will hold a System Concept Review, PDR and CDR. The Performer will hold a **Performance Metrics Review and Demonstration** with each model developed (per collaborator) and evaluated. The reviews will include statistical analysis of system performance in terms of known materials and test articles and also include a comparison of the model with the respective vendor EDS and AT equipment performance on GFE test articles and materials.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will deliver the software model tool kit with their CONOP and interface control document to enable users to incorporate the tool kit for their own purposes in development of X-ray systems for acquisition by TSA.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but is not limited to) the physical designs, optical system designs, hardware, parts lists, software (source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment.

Major milestones and deliverables are summarized in the following table.

Table 10, Major Milestones and Deliverables Summary, Task 2.5, Monte Carlo Model for X-ray Systems
Base Period: Months 1-15

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule, SCR	<1
2	PDR	2
3	CDR	5
4	Test plan submission	5
5	Test cases begin	7
6	Interim Model Metrics Review	10
7	Test cases end	14
8	Final Model Metrics Review	15
9	System Design Document	15
10	S/W Tool Kit	15
11	CONOP & ICD	15
12	Final Technical Report	15
13	Test Report	15
14	Monthly Status Report	Monthly
15	Quarterly Status Review	Quarterly
16	Meeting Minutes	Note 1
17	Presentations	Note 2

The anticipated period of performance is up to 15 months. The Government may consider shorter or longer periods of performance with adequate supporting rationale.

The PoP will include a Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the Software Tool Kit and the final design document provided by the Performer(s) to the Government. The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

1.8.5.3 Task Area 3: Test and Evaluation Support

Note an organization that submits a proposal on task 3.2 is not permitted to propose on other tasks or propose as a subcontractor to an organization submitting a proposal on other tasks. Proposers on other tasks in this BAA may not be a proposer or subcontractor to an organization proposing on task 3.2.

Task 3.1 Current EDS/AT platform detection assessment

Task 3.1.1 System Testing
Base Period: Months 1-14

This task will begin with an assessment of EDS and AT system performance against a range of TSA explosive threat classes at a Government selected test site. The assessment will be performed and supported by the EDS/AT equipment manufacturer as the Performer.

The Performer will develop a plan to assess performance against the TSA tiered improvised explosive threat detection standard. The Performer will prepare a test plan for submission and approval by DHS S&T prior to testing. The plan will recommend a Performer's certified platform (or near certified platform) and include the Performer's support at a DHS S&T selected site. Testing will be coordinated by an independent test organization with joint participation by the Performer.

The core objective is to determine performance against improvised explosive threat classes with test articles and bags including varying stream-of-commerce clutter and complexity. Testing will explore multiple performance areas in terms of false alarm rates and probability of detection over multiple test scenarios and include collection and archiving of signature data. Two areas of specific exploration are described in subtask 1 and 2 below.

The test site will be chosen by DHS S&T having the capability to handle threat weight quantities of conventional and emerging threat materials. Some materials have been previously tested to characterize checked bag and check point performance and some have not. There will be two separate testing periods of up to 60 days each per the milestone schedule shown in Table 11. The test site, periods and durations are subject to change at the discretion of DHS S&T.

The Performer will ship the selected platform (after DHS S&T approval) to the test facility, unpack, install and perform initial operational set-up. The performer will provide support during the DT&E periods. If applicable after the first testing period, the Performer may incorporate minor equipment changes for collection of additional data at a second test period. For performers working on Subtask 1 and 2 below, a second test period may or may not be warranted.

The collected signature data and test results will be provided to the Performer and DHS S&T by the test organization after completion of each testing window. Within 30-days

after the testing is completed the Performer will hold a Test Review and provide an assessment of the testing results along with possible areas and techniques for improvement.

Upon completion of testing for both test window periods, the Performer will pack and ship the equipment to a Performer's location of choice within 20 days. If a performer chooses to utilize only one test period, the equipment shall be packed and shipped after that one period.

Specific objectives of this task are as follows to explore and assess detection capability trade space for EDS and AT equipment. The paths forward may include: 1. short-term solutions for software/algorithm retro-fit of deployed systems; 2. modified hardware baseline for existing deployed systems; and/or 3. incorporation of trade study learning into the architecture design baseline as a de-novo system. However, note the architectural view analysis is a small, limited scope effort and is not to develop a fully detailed de-novo architecture as requested in Task Area 5.

For short-term solutions, the goal is applying either algorithmic techniques or simple equipment modifications that enable significant reduction of false alarm rates against detection standards and reduced threat mass. The test and evaluation objectives for each subtask are outlined below.

Subtask 1. Trade Study for existing qualified checked point and carryon X-ray scanners.

Determine the available trade space within an existing hardware platform (EDS or AT) for false alarms, expanded threat region of responsibility, and threat mass reduction. Goals for improvement are below:

a. False alarm reduction of 50%
b. Expand threat region of responsibilities and assess detection/false alarm capability
c. Threat mass reduction of 30% and corresponding detection/false alarm capability

Subtask 2. Expanded threat class assessment beyond certification standard.

Assess the existing hardware platform detection capability for new threat materials that fall within the detection capability of deployed equipment but have not as yet been part of the current TSA detection standard. DHS will provide these materials and their characterization. The objective is to evaluate detection and false alarm performance along with various threat mass scenarios. These materials are described generally below in 3.1.2 subsection d. "Key Threat Materials."

The subtasks 1 and 2 may be proposed individually. Any subtask proposed should be priced separately. As a goal, the duration of these subtasks are 12 months after contract award. A trade-space matrix of the approach and results is a deliverable for both subtasks and address Pfa, Pdet and threat mass. The subtask deliverable will also include a presentation of a notional architectural view illustrating method(s) for incorporation of suggested changes along with the business case.

Task 3.1.2 Test Bed Prototype Experiments (Optional Task)
Optional Period, (task start and duration proposed by offeror).
After testing during test window one, the Performer will analyze the test results and generate architectural designs for algorithms and/or hardware subsystems with limited prototyping as appropriate that address the key technical areas for improvement. The Performer will provide the system platform for a second window of testing and prototyping as practical.

The Performer may also incorporate additional signature discriminating techniques into a GFE test bed prototype (a description of the test bed is in Appendix G).

The Performer will provide a test and evaluation report of the results for each testing period along with recommended paths forward to mitigate any areas of weakness and suggest future architectural changes. Test reports are due 30 days after test completion. Other results, findings and analysis from this task are to be provided in the form of design reviews, demonstrations and incorporation into reports. Offerors are to provide a separate cost proposal for this optional task.

Documentation, demonstrations and reviews
The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

The Performer will hold a Test Readiness Review prior to testing at test window one and test window two. A system design review will be held to review any system baseline changes or experimental testing concepts a minimum of 30 days prior to testing. A Signature and Performance Metrics Review and Demonstration will be held. The PDR and CDR guidelines are in Appendix E and can be tailored based on applicability.

A test plan and test report will also be generated for each DT&E period. The test plan will be submitted to DHS S&T for approval prior to final testing.

The **Signature and Performance Metrics Review and Demonstration** is a critical Task milestone. The review will include statistical analysis of system performance and signature discrimination as well as real-time demonstrations confirming system performance. Test and evaluation results will be documented in a Test Report.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T

anticipates attendance by other awardees on this targeted BAA at reviews as appropriate and IAW with NDAs and measures to protect all performers' intellectual property and competition sensitive information. Presentations may be sanitized of competition sensitive information when reviewed with other performers.

The Performer will generate and deliver a System Design Document covering all tasks which will include (but is not limited to) the physical designs, optical system designs, hardware, parts lists, system interfaces, software architecture and design (including source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment.

Specifications and descriptions of the components for prototyping and algorithm enhancements setup will be included along with block diagram of the system and a description of the operating characteristics will be provided.

Additional detailed description of key milestones and deliverables follows.

a. Industry Day Presentations

   The scientific theory, experimental methods and results showing the inherent capability of the measurement technique and method will be presented at an Industry Day in Washington, DC. Two industry days per year shall be required. Each industry day event will require attendance by key staff and PIs and cover two days of presentation activity with multiple performers and DHS staff.

b. Signature Testing, Demonstration and Metric Review

   Full size test bags and test articles will be prepared by the government with target materials of interest along with background clutter and other innocuous materials. The performer will analyze the bag contents with the experimental test setup and demonstrate the ability to find and characterize the target material within the test bag. The Government will supply test articles that progress from simple compounds to more complex test articles with extensive clutter along with threat analogs or simulants to verify performance and detection capability. The Performer may also provide test articles and methods independent of Government provided articles. Detection performance will be demonstrated in terms of ROC curves and other appropriate detection and classification evaluation techniques. A Test Plan and Test Report will be generated as two deliverables.

c. System Reviews and Reports

   The detection threat list, provided by the Government, will consist of analogs, stimulants, precursors, and test articles, which will increase in complexity as the project progresses.

d. Key Threat Materials

   The goal is enhanced detection with reduced false alarm rates for improvised explosive threats with the following characteristics:

- Improvised explosive threats in various physical forms (i.e. powders, liquids, slurries, and solids)
- Improvised explosive threats with large bulk form factors
- Improvised explosive threats with small form-factors (i.e. thin dimensions and large aspect ratios (sheets)
- Chlorate mixtures
- Hydrogen peroxide (HP) with various fuel concentrations

Major Milestones and Deliverables Summary are shown in the following table.

Table 11, Major Milestones and Deliverables Summary, Task 3.1.1 System Testing Base Period: Months 1-14

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	<1
2	Test Readiness Review	1
3	Test Plan	1
4	Test Window 1	3
5	Signature, Metrics Review & Demonstration	6
6	Test Report (initial analysis)	7
7	System Design Review (for test window 2)	7
8	Test Window 2	10
9	Signature, Metrics Review & Demonstration	13
10	Test Report (recommendations)	13
11	System Design Document	14
12	Final Technical Report	14
13	Monthly Status Report	Monthly
14	Quarterly Status Review	Quarterly
15	Meeting Minutes	Note 1
16	Presentations	Note 2

The anticipated period of performance (PoP) is 14 months for the Task 3.1.1 base period with an option period of up to 6 months for optional Task 3.1.2 Test Bed Prototype Experiments. Given the nature of this work and importance to the DHS S&T mission, proposed schedules for shorter periods of performance are encouraged with supporting rationale, although not at the expense of accomplishing the program and task objectives.

The PoP will include a Government evaluation of technical reports, PDR, CDR, test plans and other design documentation. This effort will conclude with a Final Signature Metrics and Performance review. The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

Task 3.2 Test Articles
Base Period: Months 1-18

The Performer will design, build and deliver various test materials and test articles as described below in support (and in support of other tasks in this BAA).

An ultimate goal is providing test articles to the DHS enterprise and supply chain that can reduce the time and cost of deployment for delivering new detection capability to TSA. The test articles should enable EDS and AT equipment developers (and third party algorithm developers) to perform extensive onsite DT&E, exercising trade-offs in acquisition hardware and algorithm development to reach certification readiness testing (or near-CRT and certification levels) prior to formal Government IT&E.

The delivered test articles will be used for demonstration and validation of signature discrimination technology in multiple test and evaluation scenarios. The test articles and materials will support the creation of a signature library, tests for reduction of material artifacts in X-ray scanners and to demonstrate threat-clutter discrimination algorithms in X-ray scanners.

The test articles should provide a means for extensive developmental testing of EDS and AT equipment subsystems including hardware acquisition systems as well as post-acquisition software and data processing (e.g. algorithms including threat detection).

The test article design requirements and concepts shall consider traditional EDS measurements utilizing two basic discriminating signatures; effective atomic number and density of screened objects complimented by an object-image structural information vector for classification.

The test article design requirements and concepts shall consider the new types of signature measurements that will include, but are not limited to, multiple X-ray scatter phenomena to include coherent and non-coherent, as well as phase measurements of objects.

The test articles shall support simple signature testing and scale-up in a modular, configurable manner to complex stream-of-commerce testing for robust DT&E testing phases. The test articles shall permit the addition of various types of clutter objects typical

of stream-of-commerce items and include simple and complex threat mixtures to include analogs and improvised explosive threats. The test articles shall accommodate or emulate multiple container types found in stream-of-commerce that may be used to contain threats or common benign items.

The test articles will permit various types of test materials to be used in simple individual signature tests or for more complex tests where the test materials may be grouped together such that the X-rays penetrate multiple objects with varying amounts of overlap shadow. All of the test articles should support reproducible, stable measurements. The test bags and articles will be consistent with stream-of-commerce sizes that permit easy placement (re-configuration) of threats, threat analogs and typical clutter items and objects.

A minimal number of test article versions are desired that will support EDS and AT testing. The test article reconfiguration should provide the equivalent representation of up to 2000 stream-of-commerce bags.

The test articles developed on this task will be used to develop a signature library and perform DT&E on new X-ray based prototypes and test beds by end users selected by DHS S&T as well as EDS and AT vendors at their facilities.

The Performer will design and build the following types of test articles subject to final approval by DHS S&T at a design review:

1) Three general purpose bag types representative of checked baggage; small, mid-sized, and large per TSA checked baggage standards. These will be used to support formal DT&E of acquisition EDS and AT system hardware and algorithms scaling from low to high complexity in terms of clutter and improvised explosive threats.
2) Three bag types representative of AT check point carry-on items; two carry-on roller bags, one leather brief case.
3) Two specific types of fixtures for holding chemical compounds to enable signature testing of multiple types of chemicals and clutter objects in a carousel arrangement. The fixtures should enable holding of 10 small-scale compounds in a vial or similar arrangement, on the order of 50 mL.
4) Gold Standard test bags, 2 versions. This test bag will become a standard for signature measurement at multiple geographic sites, with multiple performers and serve to fully exercise test bed prototypes, EDS and AT equipment. The gold standard test bags will permit comparative analysis of measurements performed on different equipment and at different sites by different vendors and organizations.

The design and manufacturing approach must permit stable, repeatable experiments over time, location and equipment types. One version will be delivered to performer/developers and one version will be for Government validation of metrics and performance in “blind testing.” The versions for blind testing must have tamper-proof mechanisms to prevent opening by unauthorized users.

A modular design approach is desirable to permit easy, quick periodic changing of internal objects, placement and types of materials along with varying degrees of threat-clutter complexity. The test articles should permit excursion testing and verify "the system-under-test" optical system design performance including dynamic range/energy levels associated with EDS/AT equipment across the traditional density, effective atomic coordinate ranges reflecting stream-of-commerce along with the data collection/acquisition and processing subsystems.

The Performer will hold a System Concept Review, PDR and CDR and present the test bag concepts and detailed designs prior to manufacture along with specifications and drawings. Approval by DHS S&T will be required prior to manufacture as a CDR milestone.

Quantities and types will be delivered per Table 12. Assume delivery is to TSL.

Table 12, Test Article Versions, Types and Quantities

Item	Test Article	Versions	Quantity (to users)	Total Quantity (all versions)
1	General Purpose Checked Baggage Test Bags	3	12	36
2	General Purpose Check Point Carry-on Items	3	12	36
3	Carousel, Chemical Compounds	2	12	24
4	Gold Standard Test Bags			
	a) Checked Baggage (EDS)	2	12	24
	b) Check Point (AT)	2	12	24
			Total	144

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing.

The Performer will hold a System Concept Review, PDR and CDR. The Performer will hold a **Performance Metrics Review and Demonstration** with each test article. The reviews will include statistical analysis of performance in IAW the test plan and acceptance test procedure.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but are not limited to) the physical designs, hardware, parts lists and materials and detailed drawings. Major milestones and deliverables are summarized in the following table.

Table 13, Major Milestones and Deliverables Summary, Task 3.2 Test Articles
Base Period: Months 1-18

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	<1
2	System Concept Review	6
3	PDR	10
4	CDR	14
5	Test Plan	14
5	General Test Article Delivery	4
6	(Item 1, 2 from Table 12, one set each)	
7	First Gold Standard Article set T&E	16
8	(Item 3, from Table 12 one set each)	
9	Complete General Test Article Deliveries	6
10	(Item 1, 2 from Table 12)	
11	Complete Gold Standard Article Delivery	18
12	(Item 3, from Table 12)	
13	First Gold Standard Article set T&E	16
14	(Item 4 from Table 12, one set each)	
15	Complete Gold Standard Test Article Deliveries	18
16	(Item 4 from Table 12)	
17	Final Metrics Review	17
18	System Design Document	18
19	Annual Technical Report	Annual
20	Monthly Status Report	Monthly
21	Quarterly Status Review	Quarterly
22	Meeting Minutes	Note 1
23	Presentations	Note 2

The anticipated period of performance is up to 18 months. The Government may consider shorter or longer periods of performance with adequate supporting rationale.

The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

1.8.5.4 Task Area 4: Architectural Components

Base Period: Months 1-24

EDS and AT system performance is highly dependent upon the X-ray sources and detectors that enable acquiring the information from the stream-of-commerce objects. This task will develop architectural components needed in EDS and AT systems such as sources and detectors that will be used to support EDS and AT platforms, prototype test beds and future system architecture development by providing an early start on potential "long-lead" items definition, design and prototyping. DHS S&T will consider near COTS devices that have clear immediate benefit to X-ray systems that are supportable by strong technical analytical rationale with an accompanying business case. DHS S&T is also interested in non-COTS devices, whose performance and ultimate characteristics will be defined by the analytical tasks on this BAA. A strong technical analytical rationale with an accompanying business case will also be required for the non-COTS devices.

Task 4.1 Component development
The Performer will analyze requirements from a user perspective and advanced architecture perspective, specify components, validate requirements, design, build and test innovative components to enhance the detection capability of EDS and/or AT systems.

The Performer will present the component concept(s) at a System Concept Review with rationale in the form of an extensive comparative trade-off study for anticipated system enhancements from a performance and/or cost benefit. The benefits will be defended from an operational and equipment performance aspect.

As part of the requirements analysis, detailed component specifications will be prepared and provided to DHS stakeholders to include S&T, TSA, and others as selected by DHS S&T. The Performer will introduce the preliminary component specifications to the TSA EDS/AT equipment manufacturers, DHS S&T sponsored research performers, other relevant markets and provide a report on feedback incorporating the results into a PDR. The Performer will hold a CDR prior to manufacturing the component(s);

The Performer will present a commercialization plan that will fully describe a manufacturing plan, a quality assurance plan along with the market and sales plan in order to assess the Performer's ability to successfully bring the component into the market place. Formal feedback from the TSA equipment supply chain will be included. The component supply chain necessary to produce the component in volume will be described and any associated risks or weaknesses in the component supply chain along with any quality and yield issues. The commercialization plan will provide an anticipated product cost structure and the basis including a market penetration model relating manufacturing costs, cost of goods sold, volume assumptions and end user pricing. The required capital investments will be presented as well as cash flow requirements and cash flow sources. Key strategic partnerships to ensure success will be included. The Performer will include a competitive market assessment for similar or other competitive products.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing.

The Performer will hold a System Concept Review, PDR and CDR. A preliminary commercialization plan will be held at the PDR and an updated commercialization plan at the CDR.

The Performer will hold a **Metrics Review** as a critical Task 1 Go/No Go milestone. The review will include analyses of performance relative to the specification goals.

Reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with DHS S&T selected external reviewers or consultants consisting of Government and non-government individuals as appropriate. DHS S&T anticipates attendance by other awardees on this targeted BAA at reviews.

The Performer will present a project overview, scientific theory, experimental methods and results at two industry days per year in Washington, DC. Each industry day event will require attendance by the PI and key staff. Each industry day event duration is two days.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but is not limited to) the physical designs, optical system designs, hardware, parts lists, software (source code with comments as developed

and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment. Major milestones and deliverables summarized in the following table are for the non-COTS component development. A COTS or near COTS would be expected to provide a different schedule with supporting rationale.

Table 14, Major Milestones and Deliverables Summary, Task 4.1 Component Development

Base Period: Months 1-24

Item	Milestone and Deliverable	Date (Months ACA)
1	Kickoff Review, Project Schedule	1
2	Commercialization Plan (Outline)	6
3	System Concept Review	6
4	PDR	12
5	Test Plan	18
6	CDR	18
6	T&E (laboratory)	24
7	Metrics Review	24
8	System Design Document	24
9	Delivery (option, additional quantites)	30
10	T&E at other test sites (option)	32
11	Annual Technical Report	Annual
12	Monthly Status Report	Monthly
13	Quarterly Status Review	Quarterly
14	Meeting Minutes	Note 1
15	Presentations	Note 2

The anticipated base period of performance is 24 months, with an option for an additional 12 months for delivery of additional 8 components and support for additional T&E at four sites involving X-ray system platforms to be selected by DHS S&T [*For purposes of the cost proposal, the Performer should assume one week of support at the following sites: Los Angeles, California; Boston, Massachusetts; TSL; Tyndall Air Force Base;]*. The Government may consider shorter or longer periods of performance with adequate supporting rationale. Offerors are to provide a separate cost proposal for the optional task for delivery of 8 components and additional T&E support with a period of performance of months 25-36.

The PoP will include a Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the components and the final design document provided by the Performer(s) to the Government.

The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

1.8.5.3 Task Area 5: X-Ray System Architectural Design Concepts

Task 5.1 X-Ray System Architectural Design Concepts

Task 5.1.1. X-ray System Architectural Design Concepts
Base Period: Months 1-24

This task will develop Architectural Concept(s) for a next generation system supported by analysis, simulation, modeling and some level of prototyping to verify key concepts. *Actual system development with full-scale DT&E is not performed on this Architectural Concept task.*

The Performer will develop next generation EDS and/or AT architectural concepts. The Performer may prototype key elements to verify concepts and operating principals that lead to significant gains in the following areas: improvised explosive threat detection capability in terms of Pfa and Pdet for multiple improvised explosive threat classes, screening throughput, and life-cycle cost reduction. The primary focus is improvised explosive threat detection capability with a goal of chemical identification for improvised explosive threat classes.

In order to leverage AT technology concepts for possible out of gauge applications, the Performer may consider increased tunnel sizes for AT-class equipment. The increased tunnel sizes may be up to 2x the width and up to 3.5x to 4x the height of conventional checkpoint equipment. Optical path analysis and performance should address air cargo stream-of-commerce objects.

The Performer shall generate Trade Studies that guide the architectural decisions in development of the design concepts. The Trade Studies will be presented at the reviews. The Trade Studies will address performance, cost-benefit, risk and other appropriate characteristics. A trade study matrix listing of key trades to be performed and timelines

will be provided at the post-award kickoff. The trade-off study will be a deliverable document.

The Performer will consider multiple emerging technologies in the concept development and include new improvised explosive threat signature technology, compressive measurement, coded apertures, new or innovative sources and detectors along with advanced detection, classification and reconstruction algorithms. Adaptive, dynamic compressive measurement techniques along with risk-based screening will be considered for the Architectural Concept baseline(s).

The Government is interested in high-impact approaches that may be capable for retrofitting into existing EDS and AT baselines as well as game-changing de-novo approaches. A business case will be required for either approach and will be provided by the Performer in the design reviews and final report. Additional items to guide work on this task are referenced in Appendix H.

Task 5.1.2 Test Bed Prototype Experiments (Optional task, to be exercised at DHS S&T's discretion)
Optional Task 5.1.2, Period: Months 13-24

The Performer will develop a plan for a set of experiments making use of a GFE test bed[18]. The objective of the experiments is enhanced improvised explosive threat signature discrimination and architectural innovation for life-cycle cost reduction.

The Performer's plan will outline the approach, anticipated results and benefit of conducting the experiments. The plan will indicate requested GFE/GFI, beginning and duration of the experiments (limited to 20 consecutive business days, 8 hours per day) along with the committed staff to be supplied by the Performer. The experiments may consist of special test article excursions using the Government supplied test articles or test articles provided by the Performer. The Government will furnish a list of improvised explosive threats and articles that will be made available for the experimental testing.

The Performer may provide a set of components for use in the Test Bed IAW permitted changes governed by a DHS S&T review committee. Alternatively, the Performer may reposition elements on the GFE test bed.

The Performer may suggest and make positional changes to test bed optical path to include detectors, sources, apertures and other measurement devices within the limitations of the test bed prototype. Assume a period of 20 consecutive working days (eight hours, Monday-Friday, excluding holidays) for the duration of the experimental testing.

The test site will be chosen by DHS S&T and the supporting T&E work performed by a test organization. The test organization activities will be covered in a separate Interagency Agreement by DHS S&T. The test site is assumed to be Tyndall AFB, Panama City, FL, but subject to change at the discretion of the Government. Offerors are to provide a

[18] GFE test bed. The GFE test bed capability is described in appendix G.

separate cost proposal for this optional task and also propose start date and duration for the proposed prototype experiments.

Documentation, demonstrations and reviews

The Performer will provide DHS S&T with monthly status reports on all project tasks and activities, highlighting results, challenges, opportunities, issues and risks. An annual technical report will be provided to DHS S&T covering all technical aspects of the project.

A post-award kick-off review will be held within 30 days of the contract award. A project schedule will be provided at the kick-off in Microsoft Project format. Quarterly project status reviews will be held alternating between DHS S&T in Washington, DC and the Performer's site.

The Performer will generate and provide an Interim Technical Analysis Report. The report will summarize other BAA task results and applicability to Task Area five and provide feedback, suggestions and recommendations to other task area performers.

A test plan and separate test report will also be provided for each testing activity. The test plan will be submitted to DHS S&T for approval prior to testing and provided 30 days prior to testing.

The Performer will hold a System Concept Review, PDR, interim Metrics and Performance Analysis Review and a Final Architecture & Performance Metrics Review. The Performance Metrics Reviews will include analyses of anticipated system performance goals. As a guide, items in Appendix H shall be addressed in the reviews and reports.

The Performer will present a project overview, scientific theory, experimental methods and results at two industry days per year in Washington, DC. Each industry day event will require attendance by the PI and key staff. Each industry day event duration is two days.

A test plan and test results will also be provided for the EDS and AT assessment as separate documents. The test plan will be submitted to DHS S&T for approval prior to final testing.

The reviews will be attended by the Performer and key team member staff, DHS S&T program managers and staff, along with external reviewers or consultants consisting of Government and non-government individuals as appropriate.

The Performer will generate and deliver a System Design document covering all tasks in the base period, which will include (but is not limited to) the physical designs, optical system designs, hardware, parts lists, software (source code with comments as developed and executable code), simulators, algorithms, software tools, software libraries, test beds, interfaces, test fixtures, testing and test results. All software will include a description of the runtime environment. Specifications and descriptions of the components for any experimental setups will be included along with block diagram of the system and a description of the operating characteristics.

The Performer will attend design reviews and metric reviews in support of the following tasks in this Targeted BAA as indicated in Table 15.

Table 15, Task Areas 1-4, Review Support

Task	Title	Reviews (Note 1)	Suggested number of attendees	Location	Comments
Task 1.1	X-ray Test Bed Prototype	1 per year, 2 years	2	Note 2	
Task 2.1	Information Theoretic Analysis	2 reviews, 1 year	1	Note 2	
Task 2.4	Priors Library	2 reviews, 1 year	1	Note 2	
Task 3.1	Test Articles/Bags (Requirements Review, PDR/CDR)	2 reviews, 1 year	1	Note 2	
Task 4.1	Architectural Components	2 reviews, 1 year	1	Note 2	

Notes: 1. Segregate costs in support of this task in the cost proposal. 2. Performer may participate with more attendees than recommended. For purpose of proposing costs, assume alternating trips between Washington, DC, and Los Angeles, CA, beginning in Washington, DC.

The Final Architecture & Performance Metrics Review will include (but is not limited to) the following items:

a) System design concept and architecture to include key subsystems, interfaces, functional allocation to subsystems and analyses of anticipated system performance goals
b) Identification of innovative technology, new signature measurement techniques and methods to provide enhanced detection capability and other enhanced performance metrics
c) Trade Study and Analysis that guides the architectural decisions and design
d) Specifications for required subsystem components (COTS and non-COTS)
e) Experimental and algorithmic advances for incorporation into future EDS and/or AT product baselines as well as short-term enhancements for retrofit
f) Identification of a targeted Performer's equipment platform for a prototype capable of extensive DT&E, live explosive testing and IT&E, and OT&E. This may be a stand-alone device or an add-on to existing EDS or AT equipment already deployed.
g) Rough Order of Magnitude (ROM) cost estimate for a fully implemented solution ready for extensive DT&E. The estimate should segregate the costs resulting from the proposed innovation, e.g. provide the incremental cost for incorporation into an existing EDS or AT baseline. If incorporation into an

existing equipment baseline is not appropriate, the ROM costs should provide a new EDS or AT system that incorporates the innovation.

h) Concept of operations for the equipment and highlighting any change to TSA CONOP. Note that CONOP changes are undesirable unless a strong rationale and business case is provided.

i) Notional system development plan including schedule through DT&E, long-lead critical path items, critical technology needs (COTS and non-COTS), ROM cost estimate, and potential participating partnerships and team members

j) Business case with anticipated ROI to stakeholders (S&T and TSA)

A System Design document will be delivered that will include (but is not limited to) a description of the system architecture, subsystem definition and interfaces, physical designs, hardware, test equipment, parts lists, mathematical framework, software, simulators, algorithms, software tools, test beds, and interfaces. Software descriptions will include a description of the runtime environment. Specifications and descriptions of the subsystems, key components for the full-scale experimental setup will be included along with a block diagram of the system and a description of the operating characteristics.

Major milestones and deliverables are summarized in the following tables.

Table 16, Major Milestones and Deliverables Summary,
Task 5.1.1. X-ray System Architectural Design Concepts
Base Period: Months 1-24

1	Kickoff Review, Project Schedule	1
2	Interim Technical Report	6
3	System Concept Review	12
4	Trade Study, Interim	12
5	PDR1	15
6	PDR2	22
7	Final Architecture & Performance Metrics Review	22
8	System Design Document	24
9	Final Trade Study	24
10	Annual Technical Report	Annual
11	Monthly Status Report	Monthly
12	Quarterly Status Review	Quarterly
13	Meeting Minutes	Note 1
14	Presentations	Note 2

Table 17, Major Milestones and Deliverables Summary, Option Task 5.1.2 Test Bed Prototype Experiments
Option Task 5.1.2, Period: 6 months from option award

Item	Milestone and Deliverable	Date (Months ACA-Option)
1	Test Plan	1
2	Signature & Performance Metrics Review	3
3	Test Report	3

The anticipated period of performance for Task 5.1.1 is up to 24 months for the base period with a 6 month option for Task 5.1.2. The option may be proposed during the base period months 13 through 24 or as an extension to the base period. Offerors are to provide a separate cost proposal for this optional task. The Government may consider shorter or longer periods of performance with adequate supporting rationale. The schedule in Table 17 is a suggested relative to exercise of the optional task 5.1.2

The PoP will include a Government evaluation of technical reports, various reviews including PDR, CDR, test plans and other design documentation. This effort will conclude with the delivery of the final design document provided by the Performer(s) to the Government.

The Government reserves the right to witness all Performer-conducted test activities. The Performer(s) shall provide the Government at least one week written notice prior to conducting testing.

Note 1: Presentations
The Performer shall prepare and submit an agenda two weeks prior to a scheduled review. The Performer shall prepare and submit a draft set of Presentation Charts one week prior to a scheduled review. Final charts as presented are due on CD/DVD at the beginning of the review meeting and any updates from the review are due within 5 days.

Note 2: Meeting Minutes
The Performer shall submit meeting minutes within 5 days after each meeting or review held by the Performer in support of this effort covering a summary of major points of discussion, action item assignment as agreed in the meeting and a list of attendees.

1.9 Government Representatives

Technical:
William Aitkenhead
Project Officer
Explosives Division
Science and Technology Directorate
Department of Homeland Security
Washington, DC

Contracting: Duane
Schatz Contracting
Officer
Science and Technology Acquisitions Division
Office of Procurement Operations
Department of Homeland Security
Washington, DC

2 AWARD INFORMATION

2.1 Available Amount of Funding Expected to be Awarded Through this BAA

Although subject to official fiscal appropriation and availability, it is anticipated that DHS S&T will have approximately $28.5M for all awards to be made under this BAA for the base period of performance. Multiple awards may be made in each Task Area. Additional joint-funding from the United Kingdom of Great Britain and Northern Ireland may further be provided, subject to their respective availability of funds, as well as interest in the particular proposal(s).

2.2 Limitation of Funds.

The Government reserves the right to incrementally fund contracts awarded from this BAA as provided by the FAR 52.232-22, "Limitation of Funds."

2.3 Anticipated Number of Awards

DHS S&T expects to make multiple awards for each Task Area (Task Areas 1-5) under this BAA.

2.4 Anticipated Award Types

Award type is anticipated to be in the form of a Cost Reimbursement type contract or other transaction agreement, if authorized at time of award. To be eligible for such an award, the Offeror must have an adequate accounting system, in accordance with FAR 16.301-3(a)(3).

2.5 Anticipated Period of Performance for New Awards

The period of performance varies in each of the five Task Areas, as described in paragraph 1.8.5, Statement of Work.

Offerors are encouraged to complete tasks within the suggested PoP as indicated in each task area. The Government is open to proposals that can reduce the overall schedule without a sacrifice in quality or BAA objectives.

Proposals that build on current or previous work are encouraged. If Offerors are extending work performed under other DHS projects or projects by other sponsors, the proposal must

clearly identify the point of departure and what existing work will be brought forward and what new effort will be performed under this BAA.

3 ELIGIBILITY INFORMATION

This BAA is open to **ALL** responsible sources.

Offerors may include single entities or teams from academia, private sector organizations, Government laboratories, and Federally Funded Research and Development Centers (FFRDCs), including Department of Energy National Laboratories and Centers. Teaming is highly encouraged.

3.1 Federally Funded Research & Development Centers

FFRDCs, including Department of Energy National Laboratories and Centers, are eligible to respond to this BAA, individually or as a team member of an eligible principal Offeror, so long as they are permitted under a sponsoring agreement between the Government and the specific FFRDC.

3.2 Nonprofit Organizations, Educational Institutions and Small Business Set Aside

The Government encourages nonprofit organizations, educational institutions, small businesses, small disadvantaged business (SDB) concerns, Historically Black Colleges and Universities (HBCU)/ Minority Institutions (MI) (HBCU/MIs), women-owned businesses (WB), and Historically Underutilized Business (HUB) zone enterprises as well as large businesses, academic institutions, and Government laboratories to submit research proposals for consideration and/or to join others in submitting proposals; however, no portion of the BAA will be set-aside for these special entities pursuant to FAR Part 19.502-2, because of the impracticality of reserving discrete or severable areas of research and development in any specific requirement area.

To ensure full consideration in these programs, registration in the https://baa2.st.dhs.gov/ website, described later in this document, requires the appropriate business type selection as well as accurate up-to-date information.

3.3 Organizational Conflict of Interest

Organizational Conflict of Interest issues will be evaluated on a case-by-case basis, as outlined below. Offerors who have existing contract(s) to provide scientific, engineering, technical and/or administrative support directly to the DHS S&T Directorate will receive particular scrutiny.

HSAR 3052.209-72 Organizational Conflict of Interest
(a) Determination. The Government has determined that this effort may result in an actual or potential conflict of interest, or may provide one or more Offerors with the potential to attain an unfair competitive advantage.

(b) If any such conflict of interest is found to exist, the Contracting Officer may (1) disqualify the Offeror, or (2) determine that it is otherwise in the best interest of the United States to contract with the Offeror and include the appropriate provisions to mitigate or avoid such conflict in the contract awarded. After discussion with the Offeror, the Contracting Officer may determine that the actual conflict cannot be avoided, neutralized, mitigated, or otherwise resolved to the satisfaction of the Government, and the Offeror may be found ineligible for award.

(c) Disclosure: The Offeror must represent, as part of its proposal and to the best of its knowledge that: (1) It is not aware of any facts which create any actual or potential organizational conflicts of interest relating to the award of this contract; or (2) It has included information in its proposal, providing all current information bearing on the existence of any actual or potential organizational conflicts of interest, and has included the mitigation plan in accordance with paragraph (d) of this provision.

(d) Mitigation/Waiver. If an Offeror with a potential or actual conflict of interest or unfair competitive advantage believes it can be mitigated, neutralized, or avoided, the Offeror shall submit a mitigation plan to the Contracting Officer for review. Award of a contract where an actual or potential conflict of interest exists shall not occur before Government approval of the mitigation plan.

(e) Other Relevant Information: In addition to the mitigation plan, the Contracting Officer may require further relevant information from the Offeror. The Contracting Officer will use all information submitted by the Offeror, and any other relevant information known to DHS, to determine whether an award to the Offeror may take place, and whether the mitigation plan adequately neutralizes or mitigates the conflict.

(f) Corporation Change. The successful Offeror shall inform the Contracting Officer within thirty (30) calendar days of the effective date of any corporate mergers, acquisitions, and/or divestures that may affect this provision.

(g) Flow-down. The contractor shall insert the substance of this clause in each first tier subcontract that exceeds the simplified acquisition threshold.

4 APPLICATION AND SUBMISSION INFORMATION

4.1 BAA Package Download.

This BAA package may be downloaded in its entirety from the FedBizOpps website http://www.fbo.gov or from https://baa2.st.dhs.gov .

Registration is not required to download the BAA package; however, a registration in https://baa2.st.dhs.gov/ is required to upload a response to the BAA.

4.2 Application and Submission Process

Submissions will not be accepted from organizations that have not registered. Any organization that wishes to participate in this solicitation must register at: https://baa2.st.dhs.gov/ . Interested parties are encouraged to register early in the process.

White Papers must be submitted in response to this BAA. White Papers will be reviewed and Offerors notified if a White Paper is selected for encouragement of proposal submission. Full Proposals may be submitted in response to this BAA after notification by DHS S&T.

To submit a White Paper, complete the Project Proposal Form (see Appendix I), select the appropriate submission button, fill out the requested fields, upload your files, and then submit. Users will receive confirmation of their submission via e-mail. The White Paper submission may be revised until the submission deadline. Failure to submit a White Paper will disqualify an Offeror from submitting a Full Proposal.

In teaming situations, the lead organization must remain the same on both the White Paper and the Full Proposal submission. Any Full Proposal submitted by organizations that were not the lead organization for the White Paper submission will be considered non-responsive.

Only unclassified White Papers and Full Proposals will be accepted. White Papers or Full Proposals received with any classified information will be disqualified and not evaluated.

The DHS BAA website at https://baa2.st.dhs.gov offers electronic access to BAA solicitations, frequently asked questions (FAQs), answers to FAQs, and hyperlinks to other useful information.

Please refer to the "Registration and Submission Training Guide", in the upper right hand corner of the FAQ page, for step-by-step instructions to register your company or organization and submit a White Paper and Full Proposal.

IMPORTANT: Before submitting a **White Paper and Full Proposal** for the first time, you must first register your organization and user account in the system at https://baa2.st.dhs.gov/. It is recommended that a Business Official, or an authorized representative designated by the Business Official, be the first person to register for your organization. The organization's Taxpayer Identification Number (TIN) is required during registration. (If your organization does not have a TIN, you can generate a unique ID by following the prompts provided in the system). After your organization is registered, other new users may register and associate their information with the organization's existing record. When registration is complete, users can submit and manage their proposals.

For White Paper Submission

IMPORTANT: User registration is **not sufficient** for registering the White Paper. To register your White Paper, you must log on with your credentials. Click the "Start New Proposal" side link. When the Start New Proposal page displays, pick the solicitation and topic, and then enter the title of the White Paper / Proposal that you are submitting. For this BAA, the term "topic" on the screen equates to a "task" from each of the five BAA 13-05 Task Areas. When you have entered the title, click the "Add Proposal to Activity Worksheet" button. The Proposal Activity worksheet page lists your Proposal in the In Progress section of the page. Your White

Paper is registered at this point. Repeat this step before the White Paper registration deadline for every White Paper you wish to register.

IMPORTANT: After you have completed the Coversheets and uploaded your White Paper document, **you must click on the "Submit White Paper**" button to submit the White Paper; simply uploading the document is not sufficient.

For Full Proposal Submission

After you have uploaded your Full Proposal documents, **you must click on the "Submit Proposal" button** to submit the Full Proposal; simply uploading the documents is not sufficient.

In summary, to submit your White Paper or Full Proposal, select the appropriate submission button, fill out the requested fields, upload your files, and **click on the "Submit" for White Paper or Proposal** as appropriate. Users will receive confirmation of their submission via e-mail.

You may revise your Full Proposal submission until the deadline. To revise your Full Proposal, you'll need to call the DHS BAA Website Help Desk at 703-480-7676. The Help Desk will contact the Contracting Officer for approval. With that approval, the Help Desk will open up the Full Proposal for edits.

4.3 White Paper Format and Content

DHS S&T Project Proposal Forms are being solicited in a White Paper narrative form. For the purposes of the website, a completed DHS S&T Explosives Division Project Proposal Form (an MS Word document) constitutes a White Paper. See the Anticipated Schedule of Events in **paragraph 4.6** for the due date for the White Papers (completed DHS S&T Project Proposal Forms) and for when notification of DHS S&T evaluation of White Papers will be issued via e-mail.

White Papers may not be accepted after the published due date.

White Papers should capture the essence of a proposal. The Government will evaluate the White Paper submissions to determine offerors that will be encouraged to submit a full proposal.

The listed sections in Table 18 should be included in the White Paper adhering to the page count allocation. Page counts may not exceed the section as grouped in column 4. Page count allocation changes in column 3 may be made **within** the section or grouping.

Table 18, White Paper Sections and Page Count Allocation

Section Reference	Section Title	Page Count	
		Column 3	Column 4
A.	**Statement of Problem(s) to be Solved**	0.25	0.25
B.	**S&T and TSA Mission Relevance and Benefit**	0.25	0.25
C.	**Proposed Solution**		1.75
C.1	Technical Concept	0.5	
C.2	Technical Merit and Claims with Operational Benefit	0.5	
C.3	Basis of Merit and Claims	0.5	
C.4	Competitive Analysis	0.25	
D.	**Detailed Technical Approach**		4.5
D.1	Analytical, Experimental, Prototype Approach	1	
D.2	Challenges, Risks and Mitigation	0.5	
D.3	Test Plan Concept	0.5	
D.4	Statement of Work, Schedule and Deliverables	1.5	
D.5	Key Subcontracts	1	
D.6	GFI, GFE		
D.7	Offeror's Capability		
D.8	Key Staff, Team, Partnerships and Organizational Structure		
D.9	Facilities and Equipment		
D.10	Security		
D.11	Related R&D		
E.	**Management Plan and Reporting**	1.25	1.25
F.	**Cost Estimate**		
G.	**Other DHS Support**		
H.	**Assertion of Data Rights**		
	Total	8	8

White Papers shall include, as a minimum IAW Table 18, the following:

a) Clear statement of the problem, mission relevance, benefit of the proposed solution.

b) A solution description including the core technologies, innovation, proposed metrics and the unique capabilities those technologies bring to bear on the problem. Discuss how the task performance, goals and metrics will be met, including any technical background necessary for understanding the key innovations.

c) A description of any supporting technology in terms of whether or not the offeror is dependent upon others to provide that technology or expertise. The technical roles and

key expertise of each teaming partner or subcontractors should be outlined in this section.

d) A description of tasks, milestones, and deliverables proposed for the effort. The critical path should be noted. If a period of performance is different than the suggested PoP in the Task Area, appropriate justification should be provided. Provide a clear description of **metrics and Go/No Go Decision Point** with rationale in section D.4.

e) A description of the offeror's organization and team members: identify qualifications to perform the work, lines of authority, and a summary of the management approach. Clearly identify the lead organization and the roles/responsibilities of each of the team members contributing to the technology.

f) A rough order of magnitude (ROM) cost estimate allocated to tasks including segregated by labor, non-labor, travel, ODC and major equipment purchases. Provide the basis for the ROM cost estimate.

Space permitting, the offeror may also address other elements of their technology and concept of operations.

Format and size limitations

White papers may include narrative, pictures, figures, tables, and charts in a legible size and may consist of not more than 8 (eight) pages (8.5" x 11"), and must be accompanied by two quad chart pages (each 8.5" x 11"). Therefore, the entire White Paper submission shall not exceed 10 (ten) pages. Except for text embedded in graphics or tables, all text must be no smaller than 12-point. Text embedded within graphics or tables in the body of the White Paper or the quad chart may not be smaller than 8-point. A White Paper shall consist of ONE (1) electronic file in portable document format (PDF).

Organization of Quad Charts to be submitted with White Paper

The Quad chart format and the required content are shown in Figure 3.

BAA Number & Task #	**Organization (of lead organization)**
Title:	**Date:**
Proposed Concept of Solution [Provide: Diagram or illustration plus Description Provide a concise graphic with text that will convey the essential concept of the final capability/use/deployment and its key differentiating aspects (functional or technical performance metric relating to a delivered operational context and stated benefit)]	**SOW (work to be performed)** [Provide: Major tasks to be performed and performing organization. Include other key contributing organizations]
Problem Solved and Proposed Technical Approach [Provide: What is the problem? How will the problem be approached and solved? Technical basis for achieving metrics in Quad 1. Critical technical challenge(s). Describe tasks to be performed. Describe any ongoing related efforts by the offeror. Describe the technology involved and how it will be used to solve the problem. Describe key technical challenges.]	**Schedule, Cost, Major Deliverables & PI/PM Contact Info** [Provide: Summary of key schedule milestones, reviews & metric checks on critical path to reach delivery of solution. Note key GFE/GFI. Provide cost by quarter and total cost, segregating labor and non-labor Show FTEs by quarter.]

Figure 3, Quad Chart One Format and Content

A second Quad chart using the same title block, should contain a) a CV summary of team, individuals and organizations and b) prior relevant experience and c) organization background and capability and d) other information as appropriate.

The Quad Charts shall not use any font smaller than 8-point and shall be organized as shown in Figure 3.

Export Control Marking

Potential Offerors are reminded this BAA seeks unclassified technology solutions and that White Papers may be shared with foreign government personnel. White Paper submissions are to identify any items that are potentially export-controlled; such that dissemination to these foreign government personnel may be inhibited by United States federal laws, rules, or regulations. Offerors are expected to appropriately mark proprietary and/or export controlled information contained in the white paper.

DHS S&T Project Form Preparation and Submission Guidelines

ONLY OFFERORS WHO SUBMIT A RESPONSIVE WHITE PAPER WILL BE CONSIDERED FOR FULL PROPOSALS. THE GOVERNMENT WILL ADVISE IN WRITING THOSE OFFERORS ENCOURAGED TO SUBMT FULL PROPOSALS. OFFERORS NOT ENCOURAGED TO SUBMIT A FULL PROPOSAL ARE NOT PROHIBITED FROM SUBMITTING A FULL PROPOSAL.

Feedback will not be provided to Offerors not encouraged to submit a Full Proposal.
Awards will be based on the Full Proposal.

Entries in the various sections of the Project Proposal Form should be concise. All pages shall be formatted as single-spaced on 8-1/2 by 11 inch paper with type not smaller than 12 point font. Other content such as figures, tables, diagrams and charts are encouraged and are not included in the font size limitation for the various sections of the Project Proposal Form. The font for figures, tables, diagrams or charts should have clearly legible fonts that are no smaller than 8-point font.

4.4 Full Proposal Format and Content

Full Proposals

See the Anticipated Schedule of Events in paragraph 4.6 for the due date for receipt of Full Proposals. Receipt means the uploading of the Full Proposal to the DHS S&T BAA website and receiving confirmation of submission. Full Proposals may not be accepted after the published due date. Proposals that exceed the page limit will not have the extra pages reviewed, which may affect the proposal rating.

Full Proposal Format: Volume 1 Technical Proposal; and Volume 2 - Cost Proposal

Full proposals will consist of two volumes: a Technical Proposal volume and a Cost Proposal volume.

- Paper Size – 8.5-by-11-inch paper
- Margins – 1 inch
- Spacing – Single- or double-spaced
- Font – Times New Roman, 12 point. Text embedded within graphics or tables in the body of the Project Description Form should be legible and not smaller than 8 point.
- Number of Pages –
    - Volume 1, Technical Proposal: The Official Transmittal Letter, as well as the Cover Page and the Table of Contents in the Full Proposal are not subject to the page limitation. The page limit exclusion also applies to resumes/biographical information, Teaming Agreements, Letters of Intent (LOI) and Memorandum of Agreement (MOA)/Memorandum of Understanding (MOU) and Assertion of Data Rights if and only if the main proposal write-up (within the page limitation) makes reference to the aforementioned items by referring to the appropriate appendix section

containing them. Concise proposals with fewer pages than the page limit are acceptable and encouraged if the proposal is responsive to all the BAA solicitation requirements.

- Tasks in this BAA noted as "Options," should be noted as "Option" in the proposal Technical and Cost Volumes.
- Page count limits are different for the five Task Areas as noted:
  - Task Areas 1 and 5 are page limited to **25 pages**
  - Task Areas 2, 3 and 4 tasks are limited to **17 pages** (includes an extra page allocated by proposer to any desired section)
  - The suggested page count allocations per proposal section are shown in Table 19 and Table 20. Page counts may not exceed the section as grouped in column 4. Page count allocation changes in column 3 may be made **<u>within</u>** the section or grouping.
- Volume 2, Cost Proposal: No page limitation.

- Copies – A proposal shall consist of one electronic file for the Technical Proposal volume and one electronic volume for Cost proposal volume. Electronic files will be in portable document format (PDF). Each file size must be no more than 10 MB.

Table 19, Task Areas 1 and 5, Proposal Sections and Page Count Allocation

Section Reference	Section Title	Page Count	
		Column 3	Column 4
A.	**Statement of Problem(s) to be Solved**	1	1
B.	**S&T and TSA Mission Relevance and Benefit**	1	1
C.	**Proposed Solution**		7
C.1	Technical Concept	2	
C.2	Technical Merit and Claims with Operational Benefit	2	
C.3	Basis of Merit and Claims	2	
C.4	Competitive Analysis	1	
D.	**Detailed Technical Approach**		13
D.1	Experimental, Prototype Approach	3	
D.2	Challenges, Risks and Mitigation	1	
D.3	Test Plan Concept	1	
D.4	Statement of Work, Schedule and Deliverables	5	
D.5	Key Subcontracts	3	
D.6	GFI, GFE		
D.7	Offeror's Capability		
D.8	Key Staff, Team, Partnerships and Organizational Structure		
D.9	Facilities and Equipment		
D.10	Security		
D.11	Related R&D		
E.	**Management Plan and Reporting**	3	3
F.	**Cost Summary**		
G.	**Other DHS Support**		
H.	**Assertion of Data Rights**		
	Total	25	25

Table 20, Task Areas 2, 3 and 4 Proposal Sections and Page Count Allocation

Section Reference	Section Title	Page Count	
		Column 3	Column 4
A.	**Statement of Problem(s) to be Solved**	0.5	1
B.	**S&T and TSA Mission Relevance and Benefit**	0.5	
C.	**Proposed Solution**		4
C.1	Technical Concept	2	
C.2	Technical Merit and Claims with Operational Benefit	0.5	
C.3	Basis of Merit and Claims	1	
C.4	Competitive Analysis	0.5	
D.	**Detailed Technical Approach**		10
D.1	Analytical, Experimental, Prototype Approach	2	
D.2	Challenges, Risks and Mitigation	1	
D.3	Test Plan Concept	1	
D.4	Statement of Work, Schedule and Deliverables	4	
D.5	Key Subcontracts	2	
D.6	GFI, GFE		
D.7	Offeror's Capability		
D.8	Key Staff, Team, Partnerships and Organizational Structure		
D.9	Facilities and Equipment		
D.10	Security		
D.11	Related R&D		
E.	**Management Plan and Reporting**	2	2
F.	**Cost Summary**		
G.	**Other DHS Support**		
H.	**Assertion of Data Rights**		
	Total	17	**17**

Full Proposal Content

Volume 1: Technical Proposal

Volume I of the Full Proposal shall be the Technical Proposal volume. Responsiveness to the order and content of sections listed is the following paragraph is important to assure a thorough and fair evaluation of proposals. Nonconforming proposals may be rejected without review. In particular, the Technical Proposal must cover the following points in more detail:

- Official Transmittal Letter: This is an official transmittal letter with an authorizing official signature. For an electronic submission, the letter can be scanned into the electronic proposal. The letter of transmittal shall state whether this proposal has

been submitted to another government agency other than DHS S&T, and if so, the agency and date submitted.

- Cover Page: This should include the words "Technical Proposal" and the following:
  1) BAA number
  2) Title of Proposal, BAA Task Area, and BAA Task Number
  3) Identity of prime Offeror and complete list of subcontractors, if applicable
  4) Technical contact (name, address, phone/fax, electronic mail address)
  5) Administrative/business contact (name, address, phone/fax, electronic mail address)
  6) Duration of effort (separately identify the basic effort and any options)

- Table of Contents

- Executive Summary: Summarize the Full Proposal and the expected benefits of the solution with a page limit of two pages.

- Quad Charts: See Figure 3 (page 67) for formatting and content. Revise with updates if there are changes from the prior White Paper submission.

- Proposal: This section describes the proposed work and associated technical and management plan and approach. Below are the general guidelines for writing the technical volume, but the Offeror should be aware that additional details or information may be required for a particular topic. The proposer shall reference the **BAA Task Area and BAA task number and title** in their response.

- **Restrictions:** *Note an organization that submits a proposal on task 3.2 is not permitted to propose on other tasks or propose as a subcontractor to an organization submitting a proposal on other tasks. Proposers on other tasks in this BAA may not be a proposer or subcontractor to an organization proposing on task 3.2.*

- Proposal Sections: The proposal **shall have the following sections by title and sequential order.** The proposal shall address and describe the following section topics in **adequate detail** for a full assessment of the submitted proposal.

A. Statement of Problem(s) to be Solved

Understanding the problem and the description of the problem or problem set being solved is central to the proposer's subsequent proposal section and narratives. The problem statement(s) must be clear in order to assess mission relevance and the applicability of the proposed solution and accompanying metrics. The problem(s) must be described in specific terms to permit rigorous evaluation of the proposed technology solution(s).

B. S&T and TSA Mission Relevance and Benefit

The problem and solution must have high mission relevance, operational context and benefit to the S&T and TSA stakeholders. The proposer shall describe why the selected problem(s) are important and the impact of the proposed solution along with the counter position of the impact if the proposed solution is not provided or not available to TSA.

C. Proposed Solution

C.1 Technical Concept

A concise description of the concept and proposed solution shall be provided and may include figures, diagrams, charts, flow diagrams, equations and other methods to ensure the essential concepts are well explained in addition to a narrative description. Innovative aspects should be clear and describe why the concept is significantly better than alternatives.

C.2 Technical Merit and Claims with Operational Benefit

In reference to BAA Task Areas 1, 2, 3 (Task 3.1), 4 and 5, the technical merit in numeric terms should be provided along with functions and features anticipated when transitioned and deployed in aviation security. The technical benefits should be translated to operational benefit accompanied by numerical metrics if possible. Metrics shall be proposed that will be used for evaluation during the project at various milestones or phases. Metrics should be considered in the context of both equipment performance and operational benefit. This BAA is seeking significant enhancement in metrics for discrimination and detection capability; incremental advances to current state-of-the-art equipment are not being sought on this BAA.

In cases where metrics or parameters are not easily quantifiable at the proposal submission stage, state what metric measures or categories will be used and when the numerical values or targets can be established. The proposed technical approach and plan should identify when and how the metric goals will be obtained along with how the proposed solution will meet the metric goals upon delivery.

In reference to BAA Task Area 3, **Test & Evaluation Support (Task 3.2) Test Articles**, the proposer shall address Technical Merit and Claims with Operational Benefit within the context and goals of this BAA and use of the test articles for specific support to Task Areas 1, 2, 4 and 5, e.g. what is the technical merit, claims and benefit of the proposed concept for test articles that will provide benefit to the Performers and users on Task Areas 1, 2, 4 and 5, including the Government over

possible other technical approaches for test article design and manufacture including DHS T&E and IT&E.

C.3 Basis of Merit and Claims

The basis of merit, claims and metrics should be convincing, substantiated by appropriate methods and may contain the following items as an example (for signature measurement technology), providing:

- A clear description of the scientific theory and technology. Include sufficient detail to show how the approach delivers measurements or signatures needed to differentiate the improvised explosive threat from benign materials and clutter with similar properties as measured by traditional, dual energy X-ray scanners. Provide rationale or evidence the technique can scale in threat complexity, clutter and size for transition to TSA procured equipment.
- Corroborating technical materials. Feasibility calculations and simulations to show that the technology as it exists or proposed can scale to the baggage inspection environment providing an argument for practical utility including a projection of cost, size and throughput and other practical considerations.
- A collection of engineering papers and/or patents related to the technology may be referenced that support the merit or claims.
- Test data, if available, to demonstrate the method at a laboratory scale.
- Identification of experts that have performed similar or related research in the field of study with positive results.

Other examples could include analysis, models and simulation, prototyping and lab or field testing.

C.4 Competitive Analysis

Provide a competitive analysis addressing advantages/disadvantages of the proposed solution or technique over traditional approaches or other state-of-the-art methods. Results should be summarized in a comprehensive table of advantages and disadvantages relative to the intended application. Numeric metrics should be used when available or if possible. Risks and challenges should be noted.

D. Detailed Technical Approach

D.1 Analytical, Experimental, Prototype Approach

The approach that will guide the proposed work and sequence of tasks should be discussed. The work may take the form of mathematical analysis, published paper review and analysis, simulation and modeling, prototyping or other lab experiments and/or various combinations. The approach shall be described in adequate detail showing key components or modules, techniques that may include software, hardware, and/or mathematical algorithms and simulation. All approaches or methods, including hardware or software prototypes, should include the measurement or validation approach that may include physical apparatus with test articles along with analysis techniques to ensure the technical concept can be demonstrated experimentally with sufficient fidelity to meet established and proposed metrics in order to meet the project goals. The approach should be relevant to the targeted, priority threat list in Appendix D and the overall goals of this BAA.

D.2 Challenges, Risks and Mitigation

Proposers shall address challenges, risks and mitigation in responding to any BAA Task Area (1-5) with the appropriate risk metrics that include, but are not limited to, technical performance, schedule, cost (lifecycle or procurement) and security.

The Government understands that some risk is natural when striving for significantly enhanced metrics, particularly for threat-clutter discrimination. The challenges, risks and possible alternatives for risk mitigation should be described. If adoption of alternatives from the proposed baseline approach becomes necessary, discuss impacts to metrics of the best alternative: e.g. if the performance metrics would be reduced with an alternative, provide the corresponding performance metric in the proposal risk statements. Risks may be characterized as High, Moderate, Low or Extremely Low with corresponding rationale and impact.

D.3 Test Plan Concept

Validation of proposed approaches, claims and metrics of the proposed solution (for example hardware, software, algorithms, test articles) are key to this BAA; therefore a test plan concept shall be included in the proposal to discuss the test and evaluation aspects of the proposed solution and deliverables.

In reference to proposals for BAA Task Areas 1, 2, 3 (Task 3.1), 4 and 5, a test plan concept shall be described in order to ensure the ability to adequately measure the required parameters and metrics at the required fidelity associated with the proposed task, noting Task 3 test articles and the referenced targeted threat list in Appendix D. The test plan will include generation of ROC curves and other appropriate detection and classification evaluation techniques. The plan should at a minimum describe test equipment (hardware, software or simulation platform) needed, the plan for acquisition (if not already available) and supporting equipment, materials required and identified labs or test facility for experiments. If the test plan does not permit testing using real operational data or testing must be done in a

"simulated environment," the fidelity of the simulated environment must be described; the fidelity and robustness of a simulated environment (and test scenario creation) will be critical to validation.

In reference to proposals for BAA Task Area 3 (Task 3.2), a test plan concept shall be described in order to ensure the ability to adequately measure the required parameters and metrics at the required fidelity associated with the proposed task, in support of Task Areas 1, 2, 4, 5 and the referenced targeted threat list in Appendix D. The test plan will include generation of appropriate measurement metrics for T&E of the test articles. The plan should at a minimum describe test equipment needed, the plan for acquisition (if not already available) and supporting equipment, materials required and identified labs or test facility for experiments.

D.4 Statement of Work, Schedule and Deliverables

The Government's provided **SOW, Milestones and Deliverables** are outlined in this BAA for each Task Area (1-5). The Government is receptive to proposed changes with adequate justifying rationale. Any exceptions to the suggested SOW tasks (omission), schedule/scheduled event (omission or date change) or deliverables (omission or date change) shall be clearly noted in the proposer's SOW.

The Government is open to proposals that can reduce the overall schedule without a sacrifice in quality or BAA objectives. The proposer shall provide an integrated master schedule view in the proposer's SOW for the proposed research. In the document, the proposer should describe how each task will be performed and identify sub-tasks as appropriate. Task beginning and endpoints should be clear and at a time interval granularity permitting assessment of technical and schedule risk for the proposed milestones and deliverables. The **critical path(s) should be noted** with a narrative explanation and possible mitigation.

Provide a detailed schedule showing task, subtask relationships, major milestones, reviews, demonstrations and all deliverables. Major decisions points affecting a change in path in the research or development should be highlighted. GFE and GFI should be noted with the required timeframe. The schedule will include various meetings with the Government including technical interchange meetings (TIMs), industry days and various systems engineering technical reviews such as PDRs and CDRs. Documents requiring Government approval shall be noted, for example Test Plan submission and approval. In general, allow 30 days for DHS S&T review and approval of submitted documents. If a period of performance or key milestone is shorter or longer than the suggested BAA schedule or period of performance, provide appropriate rationale.

The proposed SOW, Integrated Master Schedule (IMS) and Deliverable sections respectively should be clearly marked as "SOW" and "Integrated Master Schedule" and "Deliverables" respectively. The SOW, IMS and Deliverable sections (each) shall be severable, i.e., each will begin on a new page and the following section

shall begin on a new page. It is anticipated that the proposed SOW, IMS and Deliverable sections will be incorporated as an attachment to the resultant award instrument.

In summary, proposals must include each independently, as a severable self-standing SOW, IMS and Deliverable section without any proprietary restrictions, which can be attached to the contract or agreement award. The SOW, IMS and Deliverable section, each, must begin on a new page in the proposal. Any section following the proposed SOW, IMS and Deliverable sections will begin on a new page.

Meetings, TIMs, Industry Days and Technical Reviews

Propose dates for the informal reviews, formal reviews, TIMs and presentation of results at an industry day using the suggested items from the BAA SOW in section 1.8.5. Some meetings and reviews can be combined for efficiency if occurring in a rational programmatic sequence. Additional reviews may be proposed with rationale. Any exception to the suggested reviews, either date slip or omission, shall be clearly noted. The Government is open to proposed changes with justifying rationale.

D.5 Key Subcontracts

Key subcontractors or subcontracts in the proposal should be identified. Key is defined as critical to the project in a developmental manner or critical supply chain component on the critical path from schedule or performance or if the subcontract is greater than 15% of the Prime Contractor's proposed costs.

D.6 GFI, GFE

If GFI and/or GFE are required, provide a brief summary of the required GFI and/or GFE with rationale, date needed and duration. The list should be in table format.

D.7 Offeror's Capability

Proposing organizations should describe institutional capabilities relevant to this BAA and tasks proposed. A proposing organization should summarize research, development, and commercialization capabilities including key examples of successful commercialization of developed products and/or technologies relevant to this BAA and the proposed task(s). Proposers should also provide a corporate or institutional overview with commitment to commercialization of any proposed product or technology. Non corporate entities should provide a strategy and vision of commercialization and examples of successful transition or commercialization.

D.8 Key Staff, Team, Partnerships and Organizational Structure

The team composition is critical to developing innovative approaches that can be seamlessly transitioned to TSA. Multi-disciplinary teams are highly encouraged with partnerships from universities, equipment manufacturers and other key supply-chain component organizations including those possessing hardware or software and algorithms expertise or products. A well-qualified team should provide strong

technical leadership in multiple **Technical Areas of Interest of this BAA** as noted in Section 1.8.4. The lead PI (or Co-PIs) should possess skills and technical R&D leadership in several key **Technical Areas of Interest.**

Provide a short narrative for key staff along with a **TABLE** summarizing as a minimum, the PI (and Co-PIs), other key staff, role, degree, expertise and responsibilities, tasks and percent time on the proposed project, notable awards and accomplishments and other relevant aspects. Provide resumes or *curriculum vitae* (CVs) for each of the key personnel listed in the TABLE in proposal Appendix A. These resumes and CVs do not count toward the proposal page limit and additional staff may be included that are anticipated to work on the proposed effort at a level greater than 10% on an annual basis.

D.9 Facilities and Equipment

List the location(s) where the work will be performed along with the facilities and equipment to be used. Describe any specialized or unique facilities and equipment which directly affect the effort. Key facilities and equipment should also be provided for key subcontractor team members.

D.10 Security

All proposals must be unclassified, and it is not anticipated that performer security clearances will be necessary for this program. If there are potential security issues, they should be noted.

D.11 Related R&D

Highlight relevant R&D to the proposed solution and/or other S&T/TSA projects or equipment. Outline the scope, innovation, status, outcomes and any publications or patents associated with the effort.

E. Management Plan and Reporting

Describe the management approach to include management and controls that will be in place to guide meeting performance, staffing, schedule, cost, milestones and deliverables. Describe the approach to ensure effective collaboration will be achieved across multi-disciplinary teams with monitoring of technical progress, risks and issue resolution.

Describe the proposed organizational structure and communications paths to key management with control of project resources in the performing organizations to include key subcontractors. Provide the name and position of the most senior executive (s) that will be monitoring the project along with the monitoring approach, communication and reporting path, form and frequency to the PI, program and/or project manager.

F. Cost Summary

The cost summary shall provide detail as a minimum aligned to the WBS and in adequate detail to assess the ability to meet the project objectives on a task, sub-task basis. Critical component, software, or equipment purchases shall be noted with delivery times and delivery time rationale. Long-lead items should be noted with anticipated delivery times and risk mitigation should dates not be met by suppliers.

The cost summary should be consistent with the proposed SOW. Activities such as demonstrations required to reduce the various technical risks should be identified in the SOW and reflected in the cost summary.

The cost summary should be segregated IAW options and option periods. A sample WBS is provided in Appendix J and should be followed per the Task Areas 1-5. Cost estimates to a lower level WBS than shown in Appendix J are welcomed if it provides insight to the technical solution, management plan and/or cost realism.

Options to the baseline SOW may be proposed.

G. Other DHS Support or Funding Support

In an Appendix, provide a list of any current or pending awards or proposals with DHS or other Government agencies that directly pertain to this BAA or your proposed work on this BAA. This section will not count towards the proposal page count limit. The summary list shall contain the funding organization, contracting officer, contract number, role (prime or sub), PoP, deliverables, current status, Name of PI or PM. A clear description of delineation between the funded work and the proposed work must be provided in terms of scope and deliverables.

H. Assertion of Data Rights.

Note the Assertion of data rights may be provided in an appendix. If the proposer chooses to provide the data rights assertion in the appendix, Section H, Assertion of Data Rights, should still be included in the proposal with a reference "See Appendix X [with "X" replaced with the appropriate number] Assertion of Data Rights" along with the page number. Include a summary of any assertions to any technical data or computer software that will be developed or delivered under any resultant award. This includes any assertions to pre-existing results, prototypes, or systems supporting and/or necessary for the use of the research, results, and/or prototype. Any rights asserted in other parts of the proposal that would impact the rights in this section must be cross-referenced. If less than unlimited rights in any data delivered under the resultant award are asserted, the Offeror must explain how these rights in the data will affect its ability to deliver research data, subsystems, and toolkits for integration as set forth below. Additionally, the Offeror must explain how the program goals are achievable in light of these proprietary and/or restrictive limitations. If there are no claims of proprietary rights in pre-existing data, this section shall consist of a statement to that effect.

Proposals submitted in response to this BAA shall identify all technical data or computer software that the Offeror asserts will be furnished to the Government with restrictions on access, use, modification, reproduction, release, performance, display, or disclosure. Offeror's pre-award identification shall be submitted as an attachment to its offer and shall contain the following information:

(1) Statement of Assertion. Include the following statement: "The Offeror asserts for itself, or the persons identified below, that the Government's rights to access, use, modify, reproduce, release, perform, display, or disclose only the following technical data or computer software should be restricted:"

(2) Identification of the technical data or computer software to be furnished with restrictions. For technical data (other than computer software documentation) pertaining to items, components, or processes developed at private expense, identify both the deliverable technical data and each such item, component, or process as specifically as possible (e.g., by referencing specific sections of the proposal or specific technology or components). For computer software or computer software documentation, identify the software or documentation by specific name or module or item number.

(3) Detailed description of the asserted restrictions. For each of the technical data or computer software identified above in paragraph (2), identify the following information:

(i) Asserted rights. Identify the asserted rights for the technical data or computer software.

(ii) Copies of negotiated, commercial, and other non-standard licenses. Offeror shall attach to its offer for each listed item copies of all proposed negotiated license(s), Offeror's standard commercial license(s), and any other asserted restrictions other than Government purpose rights; limited rights; restricted rights; rights under prior Government contracts, including Small Business Innovation Research (SBIR) data rights for which the protection period has not expired; or Government's minimum rights.

(iii) Specific basis for assertion. Identify the specific basis for the assertion. For example:

(A) Development at private expense. For technical data, development refers to development of the item, component, or process to which the data pertains. For computer software, development refers to the development of the software. Indicate whether development was accomplished exclusively or partially at private expense.

(B) Rights under a prior Government contract, including SBIR data rights for which the protection period has not expired.

(C) Standard commercial license customarily provided to the public.

(D) Negotiated license rights.

(iv) Entity asserting restrictions. Identify the corporation, partnership, individual or other person, as appropriate, asserting the restrictions.

(4) Previously delivered technical data or computer software. The Offeror shall identify the technical data or computer software that are identical or substantially similar to technical data or computer software that the Offeror has produced for, delivered to, or is obligated to deliver to the Government under any contract or subcontract, as well as the Government agency, contract number, and Government point of contact information. The Offeror need not identify commercial technical data or computer software delivered subject to a standard commercial license.

(5) Estimated cost of development. The estimated cost of development for that technical data or computer software to be delivered with less than Unlimited Rights.

(6) Supplemental information. When requested by the Contracting Officer, the Offeror shall provide sufficient information to enable the Contracting Officer to evaluate the Offeror's assertions. Sufficient information must include, but is not limited to, the following:

(i) The contract number under which the data or software were produced;

(ii) The contract number under which, and the name and address of the organization to whom, the data or software were most recently delivered or will be delivered; and

(iii)Identification of the expiration date for any limitations on the Government's rights to access, use, modify, reproduce, release, perform, display, or disclose the data or software, when applicable.

Export Control Marking

Potential Offerors are reminded this BAA seeks unclassified technology solutions and that Full Proposals may be shared with foreign government personnel from the United Kingdom of Great Britain and Northern Ireland. Full proposal submissions are to identify any items that are potentially export-controlled; such that dissemination to these foreign government personnel may be inhibited by United States federal laws, rules, or regulations. Offerors are expected to appropriately mark proprietary and/or export controlled information contained in the full proposal.

Ineligibility for award. An Offeror's failure to submit or complete the identifications and assertions required by this provision with its offer may render the offer ineligible for award.

It is anticipated that the proposed Assertion of Data Rights will be incorporated as an attachment to the resultant award instrument. To this end, proposals must include a severable self-standing Assertion of Data Rights without any proprietary restrictions, which can be attached to the contract or agreement award.

Volume 2: Cost Proposal

The Cost Proposal shall consist of a cover page and two parts, Part 1 and Part 2. Part 1 will provide a detailed cost breakdown of all costs by cost category by calendar/fiscal year and Part 2 will be a Cost breakdown by task/sub-task using the same task numbers in the Statement of Work. Options must be separately priced and cost proposed. No rough order of magnitude estimations will be accepted.

- Cover Page: The use of the SF 1411 is optional. The words "Cost Proposal" should appear on the cover page in addition to the following information:

    - BAA number;
    - Title of Proposal, BAA Task Area, and BAA Task Number;
    - Identity of prime Offeror and complete list of subcontractors, if applicable;
    - Technical contact (name, address, phone/fax, electronic mail address)
    - Administrative/business contact (name, address, phone/fax, electronic mail address) and;
    - Duration of effort (separately price out the basic effort and any options)

- Part 1: Detailed breakdown of all costs by cost category by calendar/fiscal year. The offeror should provide a total estimated price for major demonstrations and other activities associated with the program, including cost sharing, if any. The offeror should state whether any Independent Research and Development (IR&D) program is or will be dedicated to this effort, or if IR&D is being pursued to benefit related programs as well. Any cost sharing estimates should include the type of cost share, i.e. cash or in-kind. If in-kind is proposed, the offeror should provide a discussion of how the cost share was valued.

    - **Direct Labor -** Individual labor category or person, with associated labor hours and ***unburdened*** direct labor rates
    - **Indirect Costs -** Fringe Benefits, Overhead, G&A, etc. (***Must show base amount and rate***)
    - **Travel -** Number of trips, destinations, durations, etc.
    - **Subcontract** - A cost proposal ***as detailed as the Offeror's cost proposal*** will be required to be submitted by the subcontractor. The subcontractor's cost proposal can be provided with the Offeror's cost proposal or will be requested from the subcontractor at a later date

- **Consultant -** Provide consultant agreement or other document which verifies the proposed loaded daily/hourly rate
- **Materials -** Specifically itemized with costs or estimated costs. Where possible, indicate purchasing method, (Competition, engineering estimate, market survey, etc.)
- **Other Directs Costs -** Particularly any proposed items of equipment or facilities. Equipment and facilities generally must be furnished by the contractor/recipient. Justifications must be provided when Government funding for such items is sought
- **Fee/Profit -** Including fee percentage

- Part 2: Cost breakdown by task/sub-task using the same task numbers in the Statement of Work and Work Breakdown Structure.

The Cost Proposal should be consistent with your proposed SOW. Activities such as demonstrations required to reduce the various technical risks should be identified in the SOW and reflected in the Cost Proposal. The offeror should provide a total estimated cost for the major Research, Development, Test, and Evaluation (RDT&E) activities associated with the program. Certified cost or pricing data may be required.

4.5 Protection of Information Uploaded to BAA Website

All data uploaded to https://baa2.st.dhs.gov/ is protected from public view or download. All submissions will be considered proprietary, source selection sensitive and protected accordingly. Documents may only be reviewed by the registrant and authorized Government representatives. Offerors submitting proprietary information should specifically mark or identify any information they perceive is proprietary for which they seek added protection. Submissions to this solicitation (e.g., white papers and full proposals) constitute the offeror's consent to access of this information by authorized Government representatives, assigned evaluators, and support contractors providing administrative support to the evaluators.

4.6 Significant Dates and Times

DHS S&T plans to review all White Papers and subsequent Full Proposals in accordance with the "Anticipated Schedule of Events" set forth in the table in this section, using the evaluation criteria described in Section 5.1. After the White Paper review, DHS S&T will notify Offerors whether or not they are encouraged to submit a Full Proposal. A Review Panel will evaluate the Full Proposals using the criteria specified under the evaluation criteria set forth in Section 5.1. Following that review, Offerors will be notified whether or not their proposal has been selected for negotiation. It is anticipated that multiple awards may be made under this BAA and in each Task Area.

The Government reserves the right to fund none, some, or all of the proposals received. It is the intention upon completion of the proposal evaluation to notify Offerors of an initiation

of negotiation for awards or rejection of their proposal. Awards will be made based on the evaluation, funds availability, and other programmatic considerations.

Table 21, Anticipated Schedule of Events

Anticipated Schedule of Events		
Event	**Due Date**	**Eastern Time**
BAA Posted to Website	7 March 2013	-
Deadline for submission of BAA questions	14 March 2013	12 p.m.
White Paper Website Registration Deadline	16 April 2013	6 p.m.
White Paper Submission Due Date	16 April 2013	6 p.m.
Notification of Encouraged/Not Encouraged to Submit Full Proposal	6 May 2013	-
Full Proposal Due Date	6 June 2013	12 p.m. noon
Notification of Selection for Award Negotiations	28 June 2013	-
Contract Awards Begin	13 August 2013	-
Kickoff Meetings Begin	27 August 2013	-

4.7 Submission of Late Full Proposals

Full Proposals may not be accepted after the published due date.

4.8 Further Assistance Needed for this BAA

The applicable electronic address for all correspondence for this BAA is: BAA13-05@HQ.DHS.GOV.

For technical assistance with using the https://baa2.st.dhs.gov/ website, submit questions to the administrators at dhsbaa@reisystems.com , phone 703-480-7676.

4.9 BAA Contractual and Technical Questions

All contractual and technical questions regarding this BAA, including the published requirements and instructions, must be directed to the Contracting Officer at BAA mailbox: BAA13-05@HQ.DHS.GOV. The program and technical staff will not acknowledge, forward, or respond to any inquiries received in any other manner concerning this BAA. Contractual questions and answers will be posted periodically on the www.fbo.gov and https://baa2.st.dhs.gov websites.

5 EVALUATION INFORMATION

5.1 Evaluation Criteria

The evaluation of White Papers and Full Proposals will be accomplished through a Peer or Scientific Review using the following criteria, which are listed in descending order of

relative importance with applicability to Task Areas and Tasks as noted in Table 22-Table 31:

a) Comprehensiveness in Addressing Multiple Technical Areas of Interest and Technical Merit.

(i) **Signatures.** The proposer should provide convincing technical details and rationale for significantly enhanced signature discrimination concepts that will enhance detection capabilities and provide chemical specificity for improvised explosive threats and threat classes.

(ii) **Information theoretic measurement framework, informed measurement.** The proposer should outline key concepts and solutions for an innovative measurement strategy and system architecture(s) that jointly optimize the physical measurement system and mathematical processing framework to provide a unified or jointly designed acquisition, processing, detection, classification and reconstruction architecture or measurement system. The proposed measurement system concept should also consider compressive real-time, adaptive measurement and prior information that may optimize the joint measurement strategy based on specific tasking, communication between sensors and TSA's risk-based strategy. Joint measurement strategies including decision analytics in multiple sensors of differing modalities are of interest. Application of KECoM developed techniques is of high interest. A viable approach should include determining fundamental limits and needed parameters to achieve ROC curve performance goals for Pfa and Pdet.

(iii) **Architectures.** The proposer should outline and discuss the innovative architecture concepts and include both hardware technologies and the coupling to software and algorithmic approaches that will benefit the goals of this BAA. A table should be included that lists all **Technical Areas of Interest** of this BAA (paragraph 1.8.4) and for each area of interest, indicate the innovation (if any) proposed, benefit and how its incorporation into the proposed baseline provide significant enhancement to the improvised explosive threat detection capability and desired goals of TSA deployment of EDS or AT systems. The proposer's descriptions, discussions, explanations and/or tables should consider as a minimum the aperture size (tunnel), throughput speed and additional discriminating scatter signatures, detection capability, image quality to support TSOs and lifecycle costs.

(iv) **Algorithms.** Algorithmic approaches should identify the problem addressed in the processing flow from acquisition to classification through presentation to the TSO. In general, simple algorithmic approaches that do not provide significant enhancement to the detection capability are not of interest. The proposer should be clear on the merit in quantitative terms and provide a comparison to the state of the art approaches.

(v) **Sources and detectors.** The proposer should demonstrate an awareness of source and detector state-of-the-art and assess the role, if any, that innovation in sources and detectors may provide in improved signature development and cited areas of interest above (paragraph 1.8.4) and any other components in the acquisition hardware of EDS and/or AT equipment.

(vi) **Test articles.** Innovative concepts are desired for test articles. The test articles shall be configurable, scalable and modular in a manner to support multiple signature types, easily configured with analogs, simulants and also to support live improvised explosive threat testing. The test articles shall scale from simple signature testing and scale (modular, configurable) to complex stream-of-commerce testing in later DT&E testing phases. A minimal number of types or versions of test articles are desired that will support EDS and AT testing with both threat materials and non-threat materials. The test articles should be configurable to provide the equivalent of 500-1000 stream-of-commerce bags. Configurable means the user may easily change or replace items, materials and compounds inside the test article. However, at a later date or time, the user can repeat prior experiments with some level of reasonable correlation to prior experiments. Repeatability of tests is a desirable goal, however it is understood that precise, repeatable measurements may not be possible due to variations in chemical properties of threats, analogs or clutter.

b) **Capability, experience, history of performance, strength and multi-disciplinary composition of team members.** Recognized research leadership in the **Technologies of Interest** corresponding to the proposed Task Area/Task response and demonstrated ability to convert emerging technology or published research into deployable, transitioned products is highly desirable. The proposer's team should possess an understanding of improvised explosive threat signatures, X-ray scanning technology, information theoretic measurement framework and algorithms that would benefit the goals of this BAA. The ideal PI (or Co PIs) and team should be known for leading research as evidenced by a combination of published papers, research citations, patents and innovative product development and products.

An ideal team for this BAA would consist of a PI (or two Co-PIs) possessing: expertise in one or more areas of interest, renown for research, a high-quality publication record on relevant technology, experience with advanced laboratory experimental systems, and a proven track record of transition of research and cross-disciplinary research. As a goal, a university PI should possess credible prior work with industry; a company or industry PI should possess a demonstrated capability of joint research with universities or other research institutions. The team should possess a broad, deep reach back capability to other researchers in multiple disciplines as appropriate to the proposed Task Areas.

Given the need for multi-disciplinary applied research to achieve the goals of this BAA, teaming and collaborative relationships are encouraged as appropriate for the proposed Task Area responses. Teaming agreements and/or Letters of Intent (LOI) or Memorandums of Understanding (MOU) for collaboration and/or teaming are considered favorable for proposal evaluation. The arrangements are not required to be exclusive; multiple partnerships are encouraged. Proposers should describe the status of any teaming arrangements in their submission in the capabilities section; however the actual Teaming Agreements, LOIs and/or MOUs/MOAs may be provided in an

appendix to the proposal and are not subject to page count limitations if provided in an appendix.

The collaboration, sharing and dissemination of ideas and results from the multiple task areas are central to assisting the DHS enterprise and stakeholders transition technology to TSA for deployment in the nation's airports. DHS S&T respects an organization's intellectual property, know-how and competitive information and is seeking to foster reasonable and appropriate interaction at the many planned reviews (with Performers on this BAA) that will be held along with multiple industry days. Proposers should state their willingness and approach to collaborate, attend and support reviews, and share results in the spirit of this BAA to support technology transition.

c) **Test article team composition.** The offeror should have demonstrated the ability to produce deliverables in support of technology development work, DT&E and IT&E. The ideal team for this component would consist of a PI (or Co-PIs) with experience in development and fabrication of test articles involving chemical measurements. The team must have a credible plan and experience for developing appropriate test articles and selecting source locations for test materials with appropriate manufacturing and quality assurance plans and control methods.

d) **Management plan and schedule.** Indicate clearly dedicated PIs, CoPIs, staff and key performers that will provide a substantial amount of time and effort to the project and the role. The proposer shall indicate the staffing level in hours and percent for key staff. An information sharing approach to ensure the sharing of multi-disciplinary insights will be required. Initial results from this phase should be available in less than 24 months after award; however with appropriate rationale, the Government may consider proposed options and results that extend beyond 24 months for high-impact solutions.

e) **Commercialization vision.** Even though this BAA is developing emerging signature discrimination technology, the proposer should provide a vision of transition to deployed equipment based on the assumption of success. While not a focus on this BAA, a subsequent system development BAA will consider in detail the operating environment, storage environment, availability, reliability, maintainability, and lifecycle costs. Therefore, technology decisions in this BAA shall not pose undo limitations to achievement and successful transition to TSA.

f) **Cost realism and reasonableness.** Presentation of accurate, well-founded and reasonable estimates of all costs related to performance of the proposed effort, including an appropriate allocation of labor resources and reasonable estimates of material, equipment and travel.

Evaluation factor applicability per Task Area and Task. The applicability of the factors will vary per Task Area and Task as noted in tables 22-31 below. The factors are the same for White Papers and Full Proposals.

Table 22, Task Area 1: X-ray Test Bed Prototypes

Task Area 1: X-ray Test Bed Prototypes	Applicable
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	X
(i) Signatures	X
(ii) Information theoretic measurement framework, informed measurement	X
(iii) Architectures	X
(iv) Algorithms	
(v) Sources and detectors	X
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	X
c) Test article team composition	
d) Management Plan and Schedule	X
e) Commercialization vision	
f) Cost realism and reasonableness	X

Table 23, Task Area 2: Supporting Analytical Tasks, Task 2.1 Information Theoretic Analysis

Task Area 2: Supporting Analytical Tasks **Task 2.1 Information Theoretic Analysis**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	**X**
(iii) Architectures	
(iv) Algorithms	**X**
(v) Sources and detectors	
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 24, Task Area 2: Supporting Analytical Tasks
Task 2.2 Classification on Vendor Data Sets

Task Area 2: Supporting Analytical Tasks **Task 2.2 Classification on Vendor Data Sets**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(i) Information theoretic measurement framework, informed measurement	**X**
(ii) Architectures	
(iii) Algorithms	**X**
(iv) Sources and detectors	
(v) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 25, Task Area 2: Supporting Analytical Tasks
Task 2.3 Automated Decision Aids

Task Area 2: Supporting Analytical Tasks **Task 2.3 Automated Decision Aids**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	**X**
(iii) Architectures	
(iv) Algorithms	**X**
(v) Sources and detectors	
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 26, Task Area 2: Supporting Analytical Tasks
Task 2.4 Priors Library

Task Area 2: Supporting Analytical Tasks **Task 2.4 Priors Library**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	**X**
(iii) Architectures	
(iv) Algorithms	**X**
(v) Sources and detectors	
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 27, Task Area 2: Supporting Analytical Tasks
Task 2.5 Monte Carlo Model for X-ray Systems

Task Area 2: Supporting Analytical Tasks **Task 2.5 Monte Carlo Model for X-ray Systems**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	**X**
(iii) Architectures	**X**
(iv) Algorithms	**X**
(v) Sources and detectors	**X**
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 28, Task Area 3: Test and Evaluation Support, Task 3.1 Current EDS/AT platform detection assessment

Task Area 3: Test and Evaluation Support **Task 3.1 Current EDS/AT platform detection assessment**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	
(iii) Architectures	
(iv) Algorithms	**X**
(v) Sources and detectors	**X**
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 29, Task Area 3: Test and Evaluation Support, Task 3.2 Test Articles

Task Area 3: Test and Evaluation Support **Task 3.2 Test Articles**	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	
(iii) Architectures	
(iv) Algorithms	
(v) Sources and detectors	
(vi) Test articles	**X**
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	**X**
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 30, Task Area 4: Architectural Components

Task Area 4: Architectural Components	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	
(iii) Architectures	
(iv) Algorithms	
(v) Sources and detectors	**X**
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Table 31, Task Area 5: X-Ray System Architectural Design Concepts

Task Area 5: X-Ray System Architectural Design Concepts	**Applicable**
a) Comprehensiveness in addressing multiple technical areas of interest and technical merit	**X**
(i) Signatures	**X**
(ii) Information theoretic measurement framework, informed measurement	**X**
(iii) Architectures	**X**
(iv) Algorithms	**X**
(v) Sources and detectors	**X**
(vi) Test articles	
b) Capability, experience, history of performance, strength and multi-disciplinary composition of team members.	**X**
c) Test article team composition	
d) Management Plan and Schedule	**X**
e) Commercialization vision	**X**
f) Cost realism and reasonableness	**X**

Evaluation of White Papers and Full Proposals will be based on an assessment of the proposed solutions which are most advantageous to the Government based on the aforementioned criteria. Awards will be made based upon Full Proposal evaluation, funds availability, and other programmatic considerations, including awards to lesser rated proposals where alternative approaches and technologies are deemed to be more technically or operationally advantageous.

NOTE: DHS S&T reserves the right to select for award and fund all, some, or none of the Full Proposals received in response to this announcement.

5.2 Evaluation Panel

All properly submitted White Papers (in Project Proposal Form format) and Full Proposals that conform to the BAA requirements will be evaluated by a review panel comprised of Government technical experts drawn from staff within DHS S&T and other Federal agencies. All Government personnel are bound by public law to protect proprietary information.

Non-Government personnel will only provide administrative support to the panel and will be bound by appropriate non-disclosure agreements to protect proprietary and source-selection information. They will not be permitted to release any source-selection information to third parties, including others in their respective organization. Submissions

and information received in response to this BAA constitute permission to disclose that information to certified evaluators under these conditions.

5.3 Feedback

Due to the estimated number of White Papers to be submitted in response to this targeted BAA, the Government shall not provide feedback to Offerors not encouraged to submit a Full Proposal. The Government shall provide feedback on full proposals submitted, if requested by unsuccessful Full Proposal Offerors within three calendar days of being notified that their Full Proposal was not selected for an award.

6 AWARD ADMINISTRATION INFORMATION

6.1 Reporting

The following *minimum* deliverables will be required under traditional procurement contracts or other transactions agreements awarded to those Offerors whose Full Proposals are selected for award. Additional task-specific reports are IAW with the individual Task Areas (1-5) as described in this BAA SOW section and shall be provided by the awardee.

Program Status Report. The Contractor will deliver a monthly status report (MSR) to the DHS S&T COR, DHS S&T Explosives Division Deputy Director, and DHS S&T Financial Analyst on the 15th day of each month containing metrics pertaining to financial, schedule, and scope information, risk information, and performance assessment information a EXD provided template. This MSR will describe the previous 30 calendar days' activity, technical progress achieved against goals, difficulties encountered, recovery plans (if needed), plans for the next 30 calendar day period, and financial status. The MSR template will be provided by the DHS S&T COR to the Contractor at program kickoff. All cost and schedule information may be presented in an appendix and will not count towards any MSR page limitations specified by the DHS S&T COR. A preliminary version of the Monthly Program Status Report Form is provided in Appendix K of this BAA.

Spend Plan. Upon award, the Contractor should provide an anticipated spend plan (in EXD's provided template) for the life of the program broken out by month. Additionally, when 75% of the funding is expended, the Contractor shall alert the DHS Contracting Officer and DHS S&T COR via email and work with the both parties to initiate a mutually desired action (program close out, additional funding, or No Cost Extension).

The MSR provide a standardized format to collect the following information:

<u>Static Information (Information that does not change monthly over the project):</u>

- Project Title
- DHS Project Control #
- Period of Performance
- Principal Investigator's Name, Telephone Number, E-mail and Unclassified/Secure Facsimile Number(s)

- Performer's Financial Contact, Name, Telephone Number and E-mail

Monthly Update Information to Be Provided in Bulleted or Short Narrative Format:

- Activity During the Past Reporting Period (month)
- Progress Achieved Against Deliverable(s) During Reporting Period
- Progress Achieved Against Project Milestones and Tasks During Reporting Period
- Deliverables Submitted This Period
- Milestones Reached/Achieved This Period
- Other Noteworthy Accomplishments (meetings, presentations, publications, patent filings, etc.)
- Topics of Concern/Slippage (Technical, Schedule and/or Cost)
- Recovery Plan (if needed)
- Explicit Plans for Next Month
- Project Budget Information (Amount Spent During Reporting Period in US dollars and labor hours, including any significant equipment or material purchases, Cumulative Amount Spent Since Project Inception, and Amount of Funding Remaining)

Performers are requested to provide monthly update information only in those sections of the form that are applicable to the activities performed during the reporting period. If there is no updated information to report in a section, it can be marked "N/A" for Not Applicable, or left blank.

The following deliverables, primarily in contractor format, are anticipated as necessary. However, specific deliverables should be proposed by each Offeror and finalized with the Contracting Officer:

- Monthly Progress Status Reports
- Presentation Material
- Other Documents or Reports
- Final Report (suitable for publishing and peer review)

6.2 Project Meetings and Reviews

Program status reviews may also be held to provide a forum for reviews of the latest results from experiments and any other incremental progress towards the deliverables and major demonstrations. These meetings will be held at various sites throughout the country. For costing purposes, Offerors should assume that one of these one-day meetings will be at or near DHS S&T, Washington, DC., and one other meeting will be held at the contractor's facility or a near-by government facility. Additional task-specific reviews and meetings are IAW with individual task areas as described in the SOW section.

6.3 Additional Deliverables

Task area-specific deliverables are IAW with individual task areas as described in the BAA SOW section. Performers may propose additional task-specific deliverables as appropriate

for the proposed approach. The following milestone reports will be required for all Task Areas and Tasks.

Milestone Reports will consist of the following:
Milestone reports should include a cover page and will be electronically submitted to the Program Manager 30 days after the scheduled milestone event. Example milestone events include the PDR and CDR. These reports will describe the activity surrounding the milestone, principals involved in the actual work of the period, technical progress achieved against goals, difficulties encountered, funds expended against, recovery plans (if needed), explicit plans from this milestone moving forward, and financial status.

Milestone Meetings (for example PDR and CDR) will consist of the following:
A milestone meeting will take place at the scheduled and proper time in the milestone event between Principal Investigator, DHS S&T Program Manager, DHS component representatives, and any additional staff needed. Example milestone events include the PDR and CDR. The PDR should occur when the offeror has completed the design tradeoff phase and is ready to recommend proceeding with a single design. The CDR will occur when the offeror has completed the final design and is ready to begin the build phase of the program. This meeting will discuss technical progress achieved against goals, difficulties encountered, recovery plans (if needed), plans for the next milestone, and financial status. Location of these meetings will be determined based on the nature of the milestone, but will most likely occur at a DHS facility, a performer facility or Government test site.

7 OTHER INFORMATION

7.1 Foreign Government Participation

This BAA intends to have foreign government participation, to include access to white papers and subsequent proposal submissions for purposes of determining joint-funding and to include joint participation in overseeing projects throughout the contract period of performance. In particular, this BAA may involve cooperative activities in accordance with 6 U.S.C. §195(c) and existing bilateral international agreements on cooperation that DHS has with the United Kingdom of Great Britain and Northern Ireland. Specific details regarding foreign government cooperation are provided throughout the BAA. To review the international agreement, see the section titled, "Cooperation in Homeland/Civil Security Matters" at the following link:
http://www.dhs.gov/files/international/counterterrorism.shtm.

Foreign government personnel from the United Kingdom of Great Britain and Northern Ireland, participating as outlined in paragraph above, are bound by the non-disclosure provisions covering the protection of "business confidential" information, as stated in their international agreements with the DHS and are not be permitted to release any information to third parties, including others in their organization. By submission of a White Paper and/or subsequent Proposal, offerors are hereby consenting access to financial, confidential, proprietary, and/or trade secret marked information in the White Paper and/or subsequent Proposal to these foreign government personnel.

7.2 Government Furnished Equipment, Government Furnished Information and Facilities

The Government anticipates providing GFE and GFI as described in each BAA task area under the terms of each negotiated contract or agreement. The Government does not anticipate providing facilities under the terms of each negotiated contract or agreement.

7.3 Security Classification

No classified White Papers or Full Proposals (or portions of proposals) will be accepted.

The Contractor and its affiliates **shall not** be permitted to advertise or make endorsement claims of any kind relating to this procurement, the project sites, or the evaluated systems and processes, existing or proposed. The Contractor personnel and the Contractor shall sign non-disclosure agreements protecting all "official use only" and other sensitive aspects of the project from outside release upon contract award.

7.4 Information for White Paper and Full Proposal Respondents

This BAA is for planning purposes only. It will not be construed as an obligation on the part of the Government to acquire any products or services. No payment of direct or indirect costs or charges by the Government will arise as a result of submission of responses to this BAA and the Government's use of such information. Unnecessarily elaborate responses containing extensive marketing materials are not desired.

7.5 SAFETY Act

As part of the Homeland Security Act of 2002, Congress enacted the Support Anti-Terrorism by Fostering Effective Technologies Act of 2002 (the "SAFETY Act"). The SAFETY Act puts limitations on the potential liability of firms that develop and provide qualified anti-terrorism technologies. DHS S&T, acting through its Office of SAFETY Act Implementation (OSAI), encourages the development and deployment of anti-terrorism technologies by making available the SAFETY Act's system of "risk management" and "liability management." Offerors submitting proposals in response to this BAA are encouraged to submit SAFETY Act applications for their existing technologies. In addition, offerors may wish to apply for SAFETY Act protections for pilot studies, operational testing of prototypes or eligible intellectual properties relating to the manufacture, sale, use, or operation of anti-terrorism technologies. Offerors may contact OSAI for more information at 1-866-788-9318, helpdesk@safetyact.gov, or visit OSAI's Web site at www.safetyact.gov.

7.6 Subcontracting Plan

Successful contract proposals that exceed $650,000.00, submitted by all but small business concerns, will be required to submit a Small Business Subcontracting Plan in accordance with FAR 52.219-9, prior to award.

7.7 Certificate of Current Cost or Pricing Data

Successful contract proposals that exceed $700,000.00 may require the submission of a Certificate of Current Cost or Pricing Data in accordance with FAR 15.403-4(b)(2), prior to award.

7.8 Solicitation Provisions and Clauses

FAR 52.222-54 Employment Eligibility Verification (Jan 2009).
(a) *Definitions.* As used in this clause—

"Commercially available off-the-shelf (COTS) item"—

(1) Means any item of supply that is—

(i) A commercial item (as defined in paragraph (1) of the definition at 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in section 3 of the Shipping Act of 1984 (46 U.S.C. App. 1702), such as agricultural products and petroleum products. Per 46 CFR 525.1(c)(2), "bulk cargo" means cargo that is loaded and carried in bulk onboard ship without mark or count, in a loose unpackaged form, having homogenous characteristics. Bulk cargo loaded into intermodal equipment, except LASH or Seabee barges, is subject to mark and count and, therefore, ceases to be bulk cargo.
"Employee assigned to the contract" means an employee who was hired after November 6, 1986, who is directly performing work, in the United States, under a contract that is required to include the clause prescribed at 22.1803. An employee is not considered to be directly performing work under a contract if the employee—

(1) Normally performs support work, such as indirect or overhead functions; and

(2) Does not perform any substantial duties applicable to the contract.

"Subcontract" means any contract, as defined in 2.101, entered into by a subcontractor to furnish supplies or services for performance of a prime contract or a subcontract. It includes but is not limited to purchase orders, and changes and modifications to purchase orders.

“Subcontractor” means any supplier, distributor, vendor, or firm that furnishes supplies or services to or for a prime Contractor or another subcontractor.

“United States,” as defined in 8 U.S.C. 1101(a)(38), means the 50 States, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands.

(b) *Enrollment and verification requirements.*

(1) If the Contractor is not enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall—

(i) *Enroll*. Enroll as a Federal Contractor in the E-Verify program within 30 calendar days of contract award;

(ii) *Verify all new employees*. Within 90 calendar days of enrollment in the E-Verify program, begin to use E-Verify to initiate verification of employment eligibility of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within 3 business days after the date of hire (but see paragraph (b)(3) of this section); and

(iii) *Verify employees assigned to the contract.* For each employee assigned to the contract, initiate verification within 90 calendar days after date of enrollment or within 30 calendar days of the employee’s assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section).

(2) If the Contractor is enrolled as a Federal Contractor in E-Verify at time of contract award, the Contractor shall use E-Verify to initiate verification of employment eligibility of—

(i) *All new employees*.

(A) *Enrolled 90 calendar days or more*. The Contractor shall initiate verification of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract within 3 business days after the date of hire (but see paragraph (b)(3) of this section); or

(B) *Enrolled less than 90 calendar days*. Within 90 calendar days after enrollment as a Federal Contractor in E-Verify, the Contractor shall initiate verification of all new hires of the Contractor, who are working in the United States, whether or not assigned to the contract, within 3 business days after the date of hire (but see paragraph (b)(3) of this section); or

(ii) *Employees assigned to the contract*. For each employee assigned to the contract, the Contractor shall initiate verification within 90 calendar days after date of contract award or within 30 days after assignment to the contract, whichever date is later (but see paragraph (b)(4) of this section).

(3) If the Contractor is an institution of higher education (as defined at 20 U.S.C. 1001(a)); a State or local government or the government of a Federally recognized Indian tribe; or a surety performing under a takeover agreement entered into with a Federal agency pursuant to a performance bond, the Contractor may choose to verify only employees assigned to the contract, whether existing employees or new hires. The Contractor shall follow the applicable verification requirements at (b)(1) or (b)(2), respectively, except that any requirement for verification of new employees applies only to new employees assigned to the contract.

(4) *Option to verify employment eligibility of all employees.* The Contractor may elect to verify all existing employees hired after November 6, 1986, rather than just those employees assigned to the contract. The Contractor shall initiate verification for each existing employee working in the United States who was hired after November 6, 1986, within 180 calendar days of—

(i) Enrollment in the E-Verify program; or

(ii) Notification to E-Verify Operations of the Contractor's decision to exercise this option, using the contact information provided in the E-Verify program Memorandum of Understanding (MOU).

(5) The Contractor shall comply, for the period of performance of this contract, with the requirement of the E-Verify program MOU.

(i) The Department of Homeland Security (DHS) or the Social Security Administration (SSA) may terminate the Contractor's MOU and deny access to the E-Verify system in accordance with the terms of the MOU. In such case, the Contractor will be referred to a suspension or debarment official.

(ii) During the period between termination of the MOU and a decision by the suspension or debarment official whether to suspend or debar, the Contractor is excused from its obligations under paragraph (b) of this clause. If the suspension or debarment official determines not to suspend or debar the Contractor, then the Contractor must reenroll in E-Verify.

(c) *Web site*. Information on registration for and use of the E-Verify program can be obtained via the Internet at the Department of Homeland Security Web site: http://www.dhs.gov/E-Verify .

(d) *Individuals previously verified*. The Contractor is not required by this clause to perform additional employment verification using E-Verify for any employee—

(1) Whose employment eligibility was previously verified by the Contractor through the E-Verify program;

(2) Who has been granted and holds an active U.S. Government security clearance for access to confidential, secret, or top secret information in accordance with the National Industrial Security Program Operating Manual; or

(3) Who has undergone a completed background investigation and been issued credentials pursuant to Homeland Security Presidential Directive (HSPDET) -12, Policy for a Common Identification Standard for Federal Employees and Contractors.

(e) *Subcontracts*. The contractor shall include the requirements of this clause, including this paragraph (e) (appropriately modified for identification of the parties), in each subcontract that—

(1) *Is for*—

(i) Commercial or noncommercial services (except for commercial services that are part of the purchase of a COTS item (or an item that would be a COTS item, but for minor modifications), performed by the COTS provider, and are normally provided for that COTS item); or

(ii) Construction;

(2) Has a value of more than $3,000; and

(3) Includes work performed in the United States.

(End of Clause)

HSAR 3052.209-70 Prohibition on Contracts with Corporate Expatriates (Jun 2006)

(a) Prohibitions.

Section 835 of the Homeland Security Act, 6 U.S.C. 395, prohibits the Department of Homeland Security from entering into any contract with a foreign incorporated entity which is treated as an inverted domestic corporation as defined in this clause, or with any subsidiary of such an entity. The Secretary shall waive the prohibition with respect to any specific contract if the Secretary determines that the waiver is required in the interest of national security.

(b) Definitions. As used in this clause:

Expanded Affiliated Group means an affiliated group as defined in section 1504(a) of the Internal Revenue Code of 1986 (without regard to section 1504(b) of such Code), except that section 1504 of such Code shall be applied by substituting `more than 50 percent' for `at least 80 percent' each place it appears.

Foreign Incorporated Entity means any entity which is, or but for subsection (b) of section 835 of the Homeland Security Act, 6 U.S.C. 395, would be, treated as a foreign corporation for purposes of the Internal Revenue Code of 1986.

Inverted Domestic Corporation. A foreign incorporated entity shall be treated as an inverted domestic corporation if, pursuant to a plan (or a series of related transactions)—

(1) The entity completes the direct or indirect acquisition of substantially all of the properties held directly or indirectly by a domestic corporation or substantially all of the properties constituting a trade or business of a domestic partnership;
(2) After the acquisition at least 80 percent of the stock (by vote or value) of the entity is held—
(i) In the case of an acquisition with respect to a domestic corporation, by former shareholders of the domestic corporation by reason of holding stock in the domestic corporation; or
(ii) In the case of an acquisition with respect to a domestic partnership, by former partners of the domestic partnership by reason of holding a capital or profits interest in the domestic partnership; and
(3) The expanded affiliated group which after the acquisition includes the entity does not have substantial business activities in the foreign country in which or under the law of which the entity is created or organized when compared to the total business activities of such expanded affiliated group.
Person, domestic, and foreign have the meanings given such terms by paragraphs
(1), (4), and (5) of section 7701(a) of the Internal Revenue Code of 1986, respectively.
(c) Special rules. The following definitions and special rules shall apply when determining whether a foreign incorporated entity should be treated as an inverted domestic corporation.
(1) *Certain stock disregarded.* For the purpose of treating a foreign incorporated entity as an inverted domestic corporation these shall not be taken into account in determining ownership:
(i) Stock held by members of the expanded affiliated group which includes the foreign incorporated entity; or
(ii) Stock of such entity which is sold in a public offering related to an acquisition described in section 835(b)(1) of the Homeland Security Act, 6 U.S.C. 395(b)(1).
(2) *Plan deemed in certain cases*. If a foreign incorporated entity acquires directly or indirectly substantially all of the properties of a domestic corporation or partnership during the 4-year period beginning on the date which is 2 years before the ownership requirements of subsection (b)(2) are met, such actions shall be treated as pursuant to a plan.
(3) *Certain transfers disregarded*. The transfer of properties or liabilities (including by contribution or distribution) shall be disregarded if such transfers are part of a plan a principal purpose of which is to avoid the purposes of this section.
(d) *Special rule for related partnerships*. For purposes of applying section 835(b) of the Homeland Security Act, 6 U.S.C. 395(b) to the acquisition of a domestic partnership, except as provided in regulations, all domestic partnerships which are under common control (within the meaning of section 482 of the Internal Revenue Code of 1986) shall be treated as a partnership.
(e) Treatment of Certain Rights.
(1) Certain rights shall be treated as stocks to the extent necessary to reflect the present value of all equitable interests incident to the transaction, as follows:
(i) warrants;
(ii) options;
(iii) contracts to acquire stock;
(iv) convertible debt instruments; and
(v) others similar interests.

(2) Rights labeled as stocks shall not be treated as stocks whenever it is deemed appropriate to do so to reflect the present value of the transaction or to disregard transactions whose recognition would defeat the purpose of Section 835.

(f) *Disclosure.* The offeror under this solicitation represents that [Check one]:

__ it is not a foreign incorporated entity that should be treated as an inverted domestic corporation pursuant to the criteria of (HSAR) 48 CFR 3009.108-7001 through 3009.108-7003;

__ it is a foreign incorporated entity that should be treated as an inverted domestic corporation pursuant to the criteria of (HSAR) 48 CFR 3009.108-7001 through 3009.108-7003, but it has submitted a request for waiver pursuant to 3009.108-7004, which has not been denied; or

__ it is a foreign incorporated entity that should be treated as an inverted domestic corporation pursuant to the criteria of (HSAR) 48 CFR 3009.108-7001 through 3009.108-7003, but it plans to submit a request for waiver pursuant to 3009.108-7004.

(g) A copy of the approved waiver, if a waiver has already been granted, or the waiver request, if a waiver has been applied for, shall be attached to the bid or proposal.

(End of provision)

7.9 Acronym List

An acronym list is provided in Appendix L.

8 APPENDICES

Appendix A Technology Readiness Levels

Table 32, DHS S&T Technology Readiness Levels

(TRLs are from DoD's *Technology Readiness Assessment Deskbook*)

Level	Hardware TRL	Description	Supporting Information
1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&D). Examples might include paper studies of a technology's basic properties.	Published research that identifies the principles that underlie this technology. References to who, where, when.
2	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.	Publications or other references that outline the application being considered and that provide analysis to support the concept.
3	Analytical and experimental critical function and/or characteristic proof of concept	Active R&D is initiated. This includes analytical studies and laboratory studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. References to who, where, and when these tests and comparisons were performed.
4	Component and/or breadboard validation in a laboratory environment	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared with the eventual system. Examples include integration of "ad hoc" hardware in the laboratory.	System concepts that have been considered and results from testing laboratory-scale breadboard(s). References to who did this work and when. Provide an estimate of how breadboard hardware and test results differ from the expected system goals.
5	Component and/or breadboard validation in a relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	Results from testing a laboratory breadboard system are integrated with other supporting elements in a simulated operational environment. How does the "relevant environment" differ from the expected operational environment? How do the test results compare with expectations? What problems, if any, were encountered? Was the breadboard system refined to more nearly match the expected system goals?

Table continued: Hardware Maturity Levels

Level	Hardware TRL	Description	Supporting Information
6	System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.	Results from laboratory testing of a prototype system that is near the desired configuration in terms of performance, weight, and volume. How did the test environment differ from the operational environment? Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?
7	System prototype demonstration in an operational environment	Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, in space).	Results from testing a prototype system in an operational environment. Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?
8	Actual system completed and qualified through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation (DT&E) of the system in its intended weapon system to determine if it meets design specifications.	Results of testing the system in its final configuration under the expected range of environmental conditions in which it will be expected to operate. Assessment of whether it will meet its operational requirements. What problems, if any, were encountered? What are/ were the plans, options, or actions to resolve problems before finalizing the design?
9	Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation (OT&E). Examples include using the system under operational mission conditions.	OT&E reports.

Table continued: Software Maturity Levels

Level	Software TRL	Description	Supporting Information
1	Basic principles observed and reported	Lowest level of software technology readiness. A new software domain is being investigated by the basic research community. This level extends to the development of basic use, basic properties of software architecture, mathematical formulations, and general algorithms.	Basic research activities, research articles, peer-reviewed white papers, point papers, early lab model of basic concept may be useful for substantiating the TRL.
2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies using synthetic data.	Applied research activities, analytic studies, small code units, and papers comparing competing technologies.
3	Analytical and experimental critical function and/or characteristic proof of concept	Active R&D is initiated. The level at which scientific feasibility is demonstrated through analytical and laboratory studies. This level extends to the development of limited functionality environments to validate critical properties and analytical predictions using nonintegrated software components and partially representative data.	Algorithms run on a surrogate processor in a laboratory environment, instrumented components operating in a laboratory environment, laboratory results showing validation of critical properties.
4	Module and/or subsystem validation in a laboratory environment (i.e., software prototype development environment)	Basic software components are integrated to establish that they will work together. They are relatively primitive with regard to efficiency and robustness compared with the eventual system. Architecture development initiated to include interoperability, reliability, maintainability, extensibility, scalability, and security issues. Emulation with current/legacy elements as appropriate. Prototypes developed to demonstrate different aspects of eventual system.	Advanced technology development, stand-alone prototype solving a synthetic full-scale problem, or standalone prototype processing fully representative data sets.
5	Module and/or subsystem validation in a relevant environment.	Level at which software technology is ready to start integration with existing systems. The prototype implementations conform to target environment/ interfaces. Experiments with realistic problems. Simulated interfaces to existing systems. System software architecture established. Algorithms run on a processor(s) with characteristics expected in the operational environment.	System architecture diagram around technology element with critical performance requirements defined. Processor selection analysis, Simulation/Stimulation (Sim/Stim) Laboratory buildup plan. Software placed under configuration management. COTS/GOTS components in the system software architecture are identified.

Table continued: Software Maturity Levels

Level	Software TRL	Description	Supporting Information
6	Module and/or subsystem validation in a relevant end-to-end environment	Level at which the engineering feasibility of a software technology is demonstrated. This level extends to laboratory prototype implementations on full-scale realistic problems in which the software technology is partially integrated with existing hardware/software systems.	Results from laboratory testing of a prototype package that is near the desired configuration in terms of performance, including physical, logical, data, and security interfaces. Comparisons between tested environment and operational environment analytically understood. Analysis and test measurements quantifying contribution to system-wide requirements such as throughput, scalability, and reliability. Analysis of human-computer (user environment) begun.
7	System prototype demonstration in an operational high-fidelity environment	Level at which the program feasibility of a software technology is demonstrated. This level extends to operational environment prototype implementations, where critical technical risk functionality is available for demonstration and a test in which the software technology is well integrated with operational hardware/software systems.	Critical technological properties are measured against requirements in an operational environment.
8	Actual system completed and mission-qualified through test and demonstration in an operational environment	Level at which a software technology is fully integrated with operational hardware and software systems. Software development documentation is complete. All functionality tested in simulated and operational scenarios.	Published documentation and product technology refresh build schedule. Software resource reserve measured and tracked.
9	Actual system proven through successful mission-proven operational capabilities	Level at which a software technology is readily repeatable and reusable. The software based on the technology is fully integrated with operational hardware/software systems. All software documentation verified. Successful operational experience. Sustaining software engineering support in place. Actual system.	Production configuration management reports. Technology integrated into a reuse “wizard.”

Appendix B DARPA KECoM BAA-10-38

A selected set of references on priors follows. The BAA is available at: https://www.fbo.gov/?s=opportunity&mode=form&id=02a0f656dab936171f23d7cbcbef6a22&tab=core&_cview=0

Signal Priors:

1. W.R. Carson, M. Chen, M.R.D. Rodrigues, R. Calderbank and L. Carin, Communications Inspired Projection Design with Application to Compressive Sensing, to appear in SIAM J. Imaging Sciences, http://arxiv.org/abs/1206.1973

2. R. Muise and D Bottisti, "Compressive imaging measurement design from an image patch manifold prior", Visual Information Processing XXI, SPIE Defense, Security, and Sensing 23-27, April 2012. (http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1354777)

Task priors:

1. C. Hegde, A. C. Sankaranarayanan, and R. G. Baraniuk, "Near-Isometric Linear Embeddings of Manifolds", Statistical Signal Processing Workshop, Ann Arbor, MI, Aug., 2012. http://dsp.rice.edu/publications/near-isometric-linear-embeddings-manifolds
2. A. Ashok, J.L. Huang, and M.A. Neifeld, "Information-optimal adaptive compressive imaging," in Proc. IEEE 45th Asilomar Conf. on Signals, Systems, and Computers, 2011.

Adaptation:

1. Indyk, Price and Woodruff. "On the Power of Adaptivity in Sparse Recovery", FOCS, 2011., http://arxiv.org/abs/1110.3850

2. Akshay Soni and Jarvis Haupt "Efficient Adaptive Compressed Sensing Using Sparse Hierarchical Learned Dictionaries," 45th Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, Nov 6-9 2011. http://arxiv.org/abs/1111.6923

Appendix C Selected Technical References

I. Signature Discrimination Technology

Scatter coherent, incoherent

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90. AT: Advanced Technology; TSA term for equipment used in the Checkpoint employing X-rays to screen carry-on items and typically has only a few views unlike EDS that has many views representing the objects scanned. For more detail on the TSA Passenger Screening Program, see http://www.dhs.gov/xlibrary/assets/recovery/tsa_recovery_passenger_screening_program.pdf

Appendix D Material Threat List

The following list is representative of candidate items that should be used for signature testing and contains recommended standards, container materials, and test materials including improvised explosive threat class analogs and surrogates and/or clutter materials. It is anticipated that these materials will be combined in similar grouping in the test plans to demonstrate the capability to discriminate/classify liquids with a density near "1" and large bulk including thin form factors. Testing will scale from simple to complex scenarios of threats and clutter. Additional materials will be provided to after contract award and during the program progression.

Table 33, Test Materials I

#	Category	Test Material		#	Category	Test Material
1	Standard	Aluminum		32	Clutter	Silk
2	Standard	Carbon		33	Clutter	Wool
3	Standard	Delrin		34	Clutter	Zippers
4	Standard	Magnesium		35	Test material	70% Nitric Acid
5	Standard	Teflon		36	Test material	acetone
6	Standard	Water		37	Test material	alcohols (vodka, rum, beer (light and dark), white and red wine)
7	Container material	Aluminum		38	Test material	Ammonium nitrate
8	Container material	Cardboard		39	Test material	apple sauce
9	Container material	Cotton		40	Test material	baby foods (glass jars, plastic, and bagged)
10	Container material	Leather		41	Test material	bar soap
11	Container material	Nylon		42	Test material	bath salts (crystals)
12	Container material	PMMA		43	Test material	body lotion
13	Container material	Polyester		44	Test material	Book (hardcover and paperback)
14	Container material	Polyether ether ketene		45	Test material	cetyl alcohol
15	Container material	polyethylene (PE)		46	Test material	charcoal
16	Container material	poly-isoprene		47	Test material	cheese (hard)
17	Container material	Polyvinyl chloride (PVC)		48	Test material	cheese (soft)
18	Container material	Vinyl		49	Test material	Chloro-benzene
19	Container material	Zippers, locks		50	Test material	chocolate slab
20	Clutter	Batteries		51	Test material	Cod liver oil
21	Clutter	Camera		52	Test material	conditioner
22	Clutter	CD/DVD players		53	Test material	contact lens solution
23	Clutter	cell phone		54	Test material	cumin seasoning
24	Clutter	computers, laptops, tablets (iPad, etc.)		55	Test material	deodorant
25	Clutter	Fleece		56	Test material	diesel no. 2
26	Clutter	gel shoe inserts		57	Test material	diet soda
27	Clutter	knitting needles		58	Test material	dish washing liquid
28	Clutter	leather (coat, belt)		59	Test material	energy drink
29	Clutter	Mouse		60	Test material	Erythritol
30	Clutter	neoprene rubber (scuba, gardening)		61	Test material	ethanol/water mixture (20:80, 40:60, 60:40, 80:20)
31	Clutter	Shoes		62	Test material	ethanol

Table 33 Continued

#	Category	Test Material	#	Category	Test Material
63	Test material	Fanta	8	Test material	Mineral spirits
64	Test material	flour	8	Test material	molasses
65	Test material	fruits (oranges, apples, grapes, assorted berries and melons)	9	Test material	mouthwash
66	Test material	glue	9	Test material	Nail polish (acetone and non-acetone based)
67	Test material	gun powder - smokeless powder	9	Test material	Newspapers
68	Test material	gun powder - synthetic black powder	9	Test material	Nutella
69	Test material	gun powder -black powder	9	Test material	olive oil
70	Test material	hair gel	9	Test material	paint (oil and latex based)
71	Test material	hairbrush	9	Test material	peanut butter (chunky)
72	Test material	honey	9	Test material	peanut butter (creamy)
73	Test material	insect repellent	9	Test material	Pepper
74	Test material	Isopropyl Alcohol (IPA)	9	Test material	perfume
75	Test material	juices (orange, apple, grape, baby fruit drink)	10	Test material	play dough
76	Test material	knife (metal)	10	Test material	Potassium chlorate
77	Test material	knife (non-metal- carbon fiber, ceramic)	10	Test material	Potassium perchlorate
78	Test material	laundry detergent (powder and liquid)	10	Test material	Powdered aluminum
79	Test material	liquid flower fertilizer	10	Test material	Powdered baby formula
80	Test material	liquid soap	10	Test material	powdered drink mixes
81	Test material	magazines (Vogue, National Geographic)	10	Test material	razor (electric and regular)
82	Test material	mayo	10	Test material	salami
83	Test material	MEK	10	Test material	salt (crystalline and granulated)
84	Test material	MEKP	10	Test material	Salt/water (20:80, 60:40, 40:60)
85	Test material	Metal rods	11	Test material	sand
86	Test material	methanol	11	Test material	Sawdust
87	Test material	Milk (1%, 2%, whole, condensed), liquid baby formula (synthetic and natural)	11	Test material	shampoo

Table 33 Continued

#	Category	Test Material		#	Category	Test Material
113	Test material	shaving cream and gel		121	Test material	toothbrush (electric and regular)
114	Test material	soda		122	Test material	toothpaste
115	Test materials	Sodium chlorate		123	Test material	Vaseline
116	Test material	sugar - granulated		124	Test material	vegetable oil
117	Test material	sugar - powdered		125	Test material	vegetables (carrots, tomato, potato, broccoli)
118	Test material	sugar/water (20:80, 60:40, 40:60)		126	Test material	Vinegar
119	Test material	Tetrachloroethylene		127	Test material	water (tap, mineral and carbonated)
120	Test material	tomato ketchup		128	Test material	water/HP mixture 3%, 30%, 50%

Appendix E SCR, PDR, CDR Summary Review Guidelines

I. **SCR, PDR.** PDR (and CDR) will follow the guidelines and best practices of DHS RDT&E, INCOSE, and DAU and, with tailoring as appropriate. SCR will provide a very preliminary view of the technical concept and frame the direction of work, key requirements, trades and analysis to reach PDR.

Anticipated items to be covered at PDR:

1. Requirements Review (top-level from TSA EDS/AT platform) to include CONOPS summary and External System Interfaces

Proposed system baseline in preliminary form to include:

2. Functional baseline, diagram and performance and functional interfaces with allocation to physical architecture (hardware and software subsystems)
3. Physical architecture, system block diagram to subsystem and card-level definition
4. System and subsystem packaging
5. Subsystem interfaces
6. Software system diagram to software subsystems and interfaces
7. Software operating system environment (s)
8. Interfaces, communications
9. Information security architecture
10. Functional allocation to physical architecture (H/W and S/W)
11. Performance review and analysis of key processing threads
12. Detection processes, photon budgets
13. Processing timeline budgets
14. System throughput budgets
15. Environmental specifications
16. Risk areas
17. Test and integration plan and procedure
18. ILS, RAM plan
19. QA plan
20. CCB plan
21. Compliance matrix of requirements
22. System specifications (as proposed for manufacturing)
23. Bill-of-material estimate ROM (or budget allocated to subsystems, H/W and S/W)

II. **CDR.** CDR will provide the above PDR items in final baseline form and include the following:

1. Detailed designs of the hardware, software and packing. The detailed hardware designs will include signed-off drawings such that procurement orders can be placed if CDR passes Government review. Software designs should be to a completion level, such that detailed implementation or coding can begin if CDR passes Government review. Bill-of-material with estimated manufacturing costs.

2. Performance reviews of key processing threads and system response timelines, for example:

    a. Detection processes, adequate signal-to-noise and dynamic ranges, discrimination of threats and clutter
    b. System throughput
    c. Environment specs

    End product achievement of the PDR-allocated budgets should be supported by detailed designs along with supporting analysis and/or experiments.

Appendix F DHS S&T Collaboration Classification Solicitation Example

Note that Appendix F is an example of a prior solicitation and is shown in this BAA for illustrative purposes only. Refer to section "1.8.5.2, Task 2.2 and Task 2.5" for this BAA context.

Posted: June 21, 2012
Title: X-ray Screening Algorithm Collaboration, Solicitation Number: HSHQDC-12-R-00076
(https://www.fbo.gov/index?s=opportunity&mode=form&id=0179653b3af576113e3b0d6c17012e02&tab=core&_cview=0)

From the solicitation:

"X-ray Screening Algorithm Collaboration"

Background and Purpose: The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) has contracted with Duke University to develop advanced X-ray measurement modalities based on compressive measurement techniques and advanced classification algorithms. The focus of this work is to find new ways to efficiently detect dangerous materials in the stream of commerce that have been identified by the Transportation Security Agency (TSA).

As part of that contract, Duke University can collaborate with vendors of X-ray screening equipment wishing to be certified by the TSA to be used for screening of checked or carry-on bags. The nature of the collaboration would be for Duke to provide algorithm consultation with the experts from industry X-ray screening system vendors. The consultation would strive to understand the nature and difficulty of specific problems facing the vendor and to develop and/or modify and test algorithms and classifiers applicable to those problems. The test environment is either at Duke or the vendor as mutually agreeable. Government site testing will not be performed under this collaboration.

Level of Effort: It is anticipated that the Duke University team would provide up to 3 person months of research for a particular problem set identified by the vendor. The work and travel by the Duke University team would be supported under the DHS S&T contract. The industry partner would be expected to cover their own costs associated with the collaboration effort.

Intellectual Property: Intellectual Property that is created by Duke University would be covered under the terms of their existing contract, which includes the Federal Acquisition Regulation (FAR) clauses 52.227-1 Alt I; 52.227-2; 52.227-3; 52.227-9; 52.227-11; 52.227-14 Alts II, III, and IV; 52.227-16; and 52.227-23. The Duke performers will enter into appropriate, mutually agreeable Nondisclosure Agreements with industry partners.

The proposed effort will support collaborations between researchers at Duke University and members of the X-ray screening system vendor community, with the goal of improving the classification algorithms as manifested in reduced false alarms and improved probability of detection, while maintaining detection throughput, as applied to a wide range of X-ray sensor data. In the course of the proposed collaboration effort, industry personnel will be welcome to spend time at Duke, and Duke University personnel are likely to visit industry facilities if requested. Duke University will also plan on accommodating each qualified vendor separately for a 3-day initial seminar at Duke for classification method introduction and to determine proper interfaces to receive the data sets that may be supplied by the vendor. Vendors may plan on two additional one-day

visits to Duke for collaboration. Duke University may travel to the X-ray screening system vendor facility twice for 1-day visits during the collaboration.

The goal is to build a highly collaborative and focused research program, with the expectation that there are insights to be learned in both directions.

The proposed collaborations will be manifested in two forms. In the first, Duke University will tailor existing algorithms to X-ray screening application areas, helping define the appropriate class of algorithms for a given mission or task. In the second form of collaboration, industry personnel will help define problem classes that are unique, and for which existing algorithms are insufficient. Duke University will then work with the industry personnel to develop new algorithms, uniquely designed to meet specific explosive detection requirements.

Submission: Industry partners are invited to request, through a white paper (10 pages maximum), a collaborative work program as described above.

The white paper should outline the technical areas of interest as related to the above description, provide a short Statement of Work (SOW), identify key personnel committed to the effort with a principal investigator along with a proposed schedule for interaction, targeted X-ray screening platform (s), identification of data sets that will be provided in the collaboration and method of evaluation of results. Other pertinent information the proposer would like S&T to consider may be provided.
As a minimum, the following sections shall be provided with a narrative description:

1. Objectives, problems to be addressed
2. SOW
3. Data set (s) to be provided to Duke
4. Schedule
5. X-ray system platform status
6. Principal investigator, key participating staff
7. Agreement to a non-billable cost collaborative effort with Duke

White papers should be emailed to xxx.

Selection: The first white paper requests will be considered beginning at 1:00 p.m. EDT on June 28, with S&T approval decisions based on the capability of the industry performer, technical relevance, commitment of key personnel to the effort and a credible X-ray screening system platform. Subsequent requests will be considered on the basis of submission time and technical relevance to the X-ray screening baggage detection mission.

The algorithms to be developed reside in several broad classes, summarized (but not limited to) below:

- Nonlinear kernel-based supervised classifiers
- Semi-supervised classifiers
- Active learning
- Concept drift
- Sensor management, multi-view, and risk minimization

Appendix G X-ray Test Bed Description

The planned GFE test bed prototype will be an X-ray-based platform capable of performing measurements and characterization of full-sized stream-of-commerce checked baggage in accordance with TSA standards for EDS. It provides a robust and flexible measurement tool to collect signature data and verify notional architecture elements. The test bed will be used to collect the equivalent of full 3-D CT data fully characterizing objects, including clutter and HME threat materials.

A version is planned with a conveyor belt allowing the sample speed to be varied. Multiple X-ray sources are planned. Discrete arrays of multi-pixel, energy sensitive detectors will be included to collect transmitted X-rays, low angle scattered X-rays, and coherently scattered X-rays. Signatures are recorded as intensity against momentum transfer (in inverse angstroms) in each voxel of a 3D density map (obtained by a Compton scatter module).

The test bed will permit architecture and measurement experiments with the insertion of additional devices, including multiple source types, multiple detector types and multiple placements for sources and detectors. Additional signature techniques include, but are not limited to, coded apertures, phase measurements, and various types of coherent and incoherent X-ray scatter phenomena. The planned system will support third party placement of devices in the optical path.

Mechanical drawings and interface control drawings will be provided with sufficient accuracy and quality to permit third party design teams to design devices and place devices in the test bed.

An interface control document (ICD) will be provided describing the data, metadata formats and a CONOP document on how to interface and use the collected data in a computer-based application to facilitate third party, analytical use of the collected data. The CONOP and ICD also provide information on proper interfacing between the test bed and an IT system in general to store the collected information.

Appendix H Guidelines, Considerations and Goals for the X-ray System Architectural Design Concepts

1. Targeted applications:
    - EDS, checked bag screening with significantly improved improvised explosive threat detection capabilities
    - AT, check point screening, with improved improvised explosive threat detection capabilities. Key goals include:
        - Detection of liquid improvised explosive threats:
            - 3-1-1 in quart bags or in larger, gallon bags
            - liquids in structured or unstructured carry-on bins
        - Various form factors:
            - large bulk
            - thin dimensional form-factors with large aspect ratios (sheet)
        - Low false alarms (Pfa) for improvised explosive threats while maintaining a high detection probability (Pdet)
    - Automatic threat resolution in checked and check-point applications
    - The architectural concept should provide: new measurement basis in addition to object density and effective atomic number to detect and classify improvised explosive threats. This new information can be used either by itself or in conjunction with existing equipment capabilities to detect the broad categories of improvised explosive threats.
    - The focus is on improvised explosive threats; however detection of conventional explosive threats and weapons at or better than current TSA standards will still be required.
    - Significant enhancement of detection capability is a goal. Extensive ROC curve analysis and supporting measurements will be required on multiple threat classes and clutter to determine and achieve metrics. Possible figures of merits should be addressed that relate Pfa, Pdet, and screening throughput. For example a notional relative weighting may be: Pfa=20, Pdet=1 and throughput=1, where the higher number represents greater importance. Actual weightings will be addressed during the BAA. A measurement basis that only provides higher throughput without significantly enhanced signature discrimination is not of high interest for this BAA. The metrics must be tied to key TSA improvised explosive threat material classes with reduction of false alarm rates as the focus.
    - Capability of being integrated into existing screening systems such that current capabilities for threat display, alarm resolution, and communications are maintained and therefore no change to TSA CONOPS is required. A significant change to TSA CONOP must be highly motivated and justified by a significant enhancement of detection capability as the de-novo concept.

- For EDS, capability of deployment in the checked bag environment at a cost of ownership reduction of at least 20%, where the cost of ownership includes: equipment purchase, site construction/modification, on-going training, operation, and maintenance.
- Capability of timely introduction into the TSA procurement cycle. The goal is to achieve a certification-ready system prior to 2018 via two subsequent acquisitions; a DHS S&T system development BAA providing certification and a subsequent TSA acquisition for OT&E, procurement and deployment.

2. Provide architecture and test bed prototype demonstration of sufficient DT&E capability to scan a full-sized bag (or other suitable object) with typical background materials and extract material-specific signatures from concealed explosives, precursors, and/or approved proxies. The detection threat list for Phase 1 will consist of analogs, stimulants, and precursors. A list will be provided by the Government along with GFE test articles as the prototype demonstrates increased capability; an initial list is in Appendix D. Prototype goals are decreased false alarm rates with enhanced detection rates for the detection of:
   a) Improvised explosive threats (in powder, liquid and slurry form, containerized as selected by DHS S&T)
   b) Various form factors that will include large bulk sizes
   c) Small dimensional form-factors that will include thin dimensions, with large aspect ratios (sheet)

   Detection concepts and implementation will consist of metric driven discrimination analysis and/or experiments to include:

   a) Experimental proof of enhanced discrimination along with supporting analysis
   b) Signature measurement techniques other than density and effective atomic number measurements are of primary interest. The new techniques are not assumed to replace density and atomic number but to complement density and atomic number measurements by adding new measurement elements to a discrimination vector for enhanced detection.
   c) Unique signatures providing chemical identification are desired that are not based on conventional, EDS-CT image structure alone. A few material examples anticipated (and subject to change) for consideration are:
      i. HP in cluttered environment
      ii. HP in various concentrations along with other commercial drinks and liquids
      iii. Liquids in bags and various containers

iv. Objects of increasing complexity that will exercise the proposed technique in a structured test environment of increasing threat compounds (analogs and simulants) along with various clutter types and complexity

3. Characterize the concept of operation including data acquisition and processing so that a useful extrapolation to a realistic operational environment may be made. Depending on the technology approach this would include information regarding the expected number of detectors, detector types, sources, source types, data rates, processing power, processing time, etc. Analysis should also include practical considerations such as power requirements, size, weight, and any environmental restrictions or potential safety issues.
4. [for Task Areas 1, 3 and 5] Define an EDS/AT equipment platform for possible future prototype construction whereby the new technology can be integrated. The new technology may be stand alone or an add-on to existing EDS or AT scanning equipment. Due to the Government's interest in quickly deploying innovative signature technology, a viable EDS or AT platform for transitioning the technology of interest. A de-novo system is also of interest, particularly if significant advances in improvised explosive threat detection capabilities are evident beyond what is achievable by a retrofit approach.
5. Draft concept for a certifiable equipment platform. A viable EDS or AT platform plan must address the risks, time-to-market, and demonstrate adequate corporate institutional know-how to show that transition risks and successful deployment is minimal if funded by a future system development BAA. The draft concept will include:
    a) A pro forma equipment cost (non-recurring and recurring) for a system product ready for DT&E
    b) A pro forma concept of operations for the equipment showing essential operation in existing TSA CONOP
    c) Prototype construction and evaluation conceptual plan including schedule, cost, and potential team member participants for a subsequent system development BAA
6. Architectural Concept and Design will show an inherent capability to share EDS or AT data and classification decision making in real-time with other networked equipment, and TSA systems supporting risk-based screening that provides dynamic, adaptive tasking and threat profiles.
7. Joint Optimization of Measurement and Processing. A goal is to define innovative measurement system architectures that jointly optimize the physical measurement system and mathematical processing framework to provide a unified or jointly designed acquisition, processing, detection, classification and reconstruction architecture or measurement system. Jointly optimizing means "conditioning the

electromagnetic spectrum" with consideration of the classification goals to provide more optimum, end-to-end processing and decision making. The measurement system should also draw on KECoM program technology and consider real-time, adaptive measurement and prior information that may optimize the joint measurement strategy based on specific tasking and TSA's risk-based screening strategy. The architectural design should address and answer the following items:

a) Given the threat and clutter space, constrained by aperture size (equipment tunnel size) and required throughput, what is the number of unique or orthogonal signatures required to provide a significant enhancement of the ROC curves while maintaining or improving throughput?
b) How much information (or scans) is required for adequate reconstruction of objects and to provide adequate segmentation and ultimately automatic detection and classification?
c) Is it possible to provide feature specific detection and classification at enhanced Pdet and Pfa without image reconstruction and only employ reconstruction as an operator aid for spatial location in alarm resolution?
d) What are optimal or near optimal information measurement systems from a physical and mathematical implementation and how can prior information influence the actual measurement process adaptively in real-time?
e) For TSA's risk-based screening, how can smart, dynamically adaptive sensors and measurement processes provide operational benefit? Can other information external to the specific sensor be provided a priori to inform the measurement and detection process for improved Pdet, Pfa (such as passenger information or biometrics)? What are priors in the KECoM context, either external dynamic, external static information that may assist in enhanced Pdet, Pfa, and/or improved screening throughput?
f) Research has progressed with active learning supporting enhanced classification in multiple applications. Can the body of research be applied to EDS or AT systems and does active learning have merit for X-ray systems given the volume of stream-of-commerce data? If so, what is the improvement and how is "system qualification maintained" if active learning is employed?
g) Can other modalities and fusion be employed and effectively integrated into EDS or AT platforms providing additional information and at affordable cost? If so, how are additional modalities incorporated into joint optimization of sensing?

h) Algorithm focus often has been on detection of threats, with less emphasis on elimination or removal of clutter. It is possible to inform the measurement process of clutter objects and subsequently improve the measurement process in real-time, hence reducing the clutter information during classification processes for improved Pdet and Pfa? Can clutter be used as a prior and affect the measurement process or conditioning of the electromagnetic field to achieve benefit?

The Performer will perform the activities on Table 34, noting the key items and parameters.

Table 34, Key Activities and Parameters

#	Item	Activity and Key Parameters
1	**New signatures, orthogonal information & data**	**a)** Incorporate new signature measurement techniques, and orthogonal information/data to provide chemical identification of improvised explosive threat classes and improve discrimination of threat and clutter **b)** Goal: reduction of Pfa to less than 10% for current Pdet standard **c)** Analyze discrimination data on targets of interest, compare to traditional CT measurement for same threat class or clutter. Project the enhanced detection capability (Pdet, Pfa) and ROC curves.
2	**Macro threat properties**	**d)** Develop measurement techniques and algorithms for thin sheets threats and objects based on target critical properties including critical diameter, max and minimum target thickness. **e)** Include the effects of containers.
3	**Non-target background and clutter**	**f)** Develop and incorporate clutter rejection techniques **g)** Include non-target and non-threat materials and artifacts inherent to measurement approach (e.g. metal objects when using conventional CT)
4	**Analysis of threat target variability**	**h)** Develop signature measurements and algorithmic approaches to provide enhanced detection capability mitigating reduced detection performance due to variance in improvised explosive threat chemistry, chemical mixture ratios and threat preparation methods and processes.
5	**Information theoretic measurement framework, real-time adaptive measurement**	**i)** Define innovative measurement system architectures that jointly optimize the physical measurement system and mathematical processing framework to provide a unified or jointly designed acquisition, processing, detection, classification and reconstruction architecture or measurement system. **j)** Generate a mathematical basis set for joint acquisition and classification. Show real-time, adaptive measurement concept with the use of priors[19] to improve detection capability. Quantify the benefit.
6	**EDS, AT Projected Performance Specification**	**k)** Develop projected performance characteristics for future candidate transitioned equipment. Provide rationale, analysis and notional business case. **l)** Estimate size, weight, power, throughput, detection capability (Pdet, Pfa) and ROC curves. **m)** Provide description of sensors, source, detectors, and other critical architecture elements along with operational constraints, safety aspects.

[19] The prior library should be generated or defined from a perspective (a) signal classes, (b) task requirements, and (c) adaptation and their incorporation into the measurement process.

Appendix I Sample White Paper in "DHS S&T EXD Project Proposal Form" Format

FY 2013 PROJECT PROPOSAL FORM (for White Paper)
Project Name XXX
Name(s) and Contact Information of Performers
Name: XXX Mailing Address: XXX Telephone: XXX Fax: XXX Secure Fax: XXX Email: XXX Secure Email : XXX
Name and Contact Information of Financial Contact
Name: XXX Mailing Address: XXX Telephone: XXX Fax: XXX Email: XXX
BAA TASK AREA (and Subtask if applicable)
Requirement Addressed (Reference Technical Areas of Interest and IAW Table 18)
XXX
Summary of White Paper (IAW Table 18) Technical Approach & Project Activity
XXX
Justification & Potential Benefits/Outcomes of Project
XXX
List of Tasks and Schedule (From Contract Award Date)
Task 1: Task Name XXX (Contract Award Date to X month) Task 2: Task Name XXX (Month X to X month) … Task N: Task Name XXX (Month X to X month) (Note: POP months)
Cost of Each Task/Total Project Cost
Task 1 Cost: $ XXX Task 2 Cost: $ XXX Task N Cost: $ XXX **Total Cost: $ XXX**
Breakout and Categorization of Costs
Labor: $ XXX M&S: $ XXX Capital Equipment: $ XXX Travel: $ XXX Indirect: $ XXX Estimated Labor Hours: XX Hours Average Cost per Labor Hour: **$** XXX/hour
Description of Deliverable(s) and Schedule of Delivery
Deliverable 1: Deliverable Name XXX (Contract Award Date + X months) Deliverable 2: Deliverable Name XXX (Contract Award Date + X months) … Deliverable N: Deliverable Name XXX (Contract Award Date + X months)
Go / No Go Decision Point(s) for Project Completion

Appendix J WBS per Task Area and Individual Tasks

The following WBS should be followed; however additional detailed levels should be used to provide necessary insight to performance, cost, and risk management in addition to assessing the project cost realism. Segregate all options from baseline costs and each other.

A. Task Area 1, X-ray Test Bed Prototypes

1 Project Summary
- 1.1. Baseline Task(s)
  - 1.1.1 Technical Task and Technical Deliverables
  - 1.1.2 Project Management & Other Documentation Deliverables
- 1.2. Option Task(s)
  - 1.2.1 Technical Task & Technical Deliverables
  - 1.2.2 Project Management & Other Documentation Deliverables

B. **Task Area 2, Supporting Analytical Tasks** (use for Tasks 2.1, 2.2, 2.3, 2.4, 2.5)

1 Project Summary
- 1.1 Baseline Task(s)
  - 1.1.1 Technical Task and Technical Deliverables
  - 1.1.2 Project Management & Other Documentation Deliverables
- 1.2 Option Task(s)
  - 1.2.1 Technical Task and Technical Deliverables
  - 1.2.2 Project Management & Other Documentation Deliverables

C. **Task Area 3, T&E Support**

1 Project Summary (Task 3.1 Current EDS/AT platform detection assessment)
- 1.1. Baseline Task 1.1
  - 1.1.1 Technical Task and Technical Deliverables
  - 1.1.2 Project Management & Other Documentation Deliverables
- 1.2 Option Task(s)
  - 1.2.1 Technical Task & Technical Deliverables
  - 1.2.2 Project Management & Other Documentation Deliverables

1 Project Summary (Task 3.2 Test Articles)
- 1.1 Baseline Task(s)
  - 1.1.1 Technical Task Design and Development
  - 1.1.2 Test Articles (Build, Test, Delivery)
  - 1.1.3 Project Management & Other Documentation Deliverables
- 1.2 Option Tasks
  - 1.2.1 Technical Task Design and Development
  - 1.2.2 Test Articles (Build, Test, Delivery)
  - 1.2.3 Project Management & Other Documentation Deliverables

D. **Task Area 4, Architectural Components**

1 Project Summary

1.1 Baseline Task(s)

1.1.1 Technical Task and Development

1.1.2 Prototype (Build, Test, Delivery)

1.1.3 Project Management & Other Documentation Deliverables

1.2 Option Task(s)

1.2.1 Technical Task & Technical Deliverables

1.2.2 Prototype (Build, Test, Delivery)

1.2.3 Project Management & Other Documentation Deliverables

E. **Task Area 5, X-ray System Architectural Design Concepts**

1 Project Summary

1.1 Baseline Task(s)

1.1.1 Technical Task and Technical Deliverables

1.1.2 Project Management & Other Documentation Deliverables

1.2 Option Task(s)

1.2.1 Technical Task & Technical Deliverables

1.2.2 Project Management & Other Deliverables

Appendix K Sample DHS S&T Explosives Division "Monthly Project Status Reporting Form"

DHS S&T EXD PROGRAM
FY 2013 MONTHLY PROJECT STATUS REPORT FORM
CONTRACTOR: XXX
MONTHLY PROJECT STATUS REPORT # x
For: xxx 201X (Month/Yr.)
Date Submitted: xxx , 201X

(Must be submitted to DHS PM by 15th of following month, final template version to be supplied at award) **Deliverable:**	
Project Title: Project Name XXX	
Purchase Request/IAA No.: XXX	**Period of Performance:** Contract Award Date (C.A.D.) [xx/xx/201X] + X Months = xx/xx/201X
Principal Investigator (PI): XXX	**PI Telephone No.:** XXX
PI Email: XXX	**PI Facsimile No.:** XXX
Financial Contact: XXX	**Financial Contact Telephone No.:** XXX
DHS Program Manager: XXX	**DHS PM Telephone No.:** XXX
DHS PM Email: XXX	**DHS PM Facsimile No.:** XXX
Narrative as required.	

Appendix L Acronym List

ACA	After contract award
AFB	Air Force base
AIT	Advanced imaging technology
AT	Advanced technology
BAA	Broad Agency Announcement
BLS	Bottle liquid scanner
CA	Cooperative agreement
CAXSI	Coded aperture X-ray scatter imaging
CCB	Configuration Control Baseline/Configuration Control Board
CD/DVD	Compact disc/digital video disc
CDA	Calendar days after
CDR	Critical design review
CE	Conformité Européne
CFR	Code of Federal Regulations
CONOPS	Concept of operations
COR	Contracting Officer's Representative
COTS	Commercial-off-the-shelf
CRT	Certification readiness testing
CT	Computed tomography
CV	*curriculum vitae*
DAC	Days after contract award
DARPA	Defense Advanced Research Projects Agency
DAU	Defense Acquisition University
DHS S&T	Department of Homeland Security Science and Technology Directorate
DOE	Department of Energy
DT&E	Development, test, & evaluation
EDS	Explosives detection system
EXD	Explosives Division
FAQ	Frequently asked questions
FAR	Federal Acquisition Regulations
FCC	Federal Communications Commission FedBizOps
	Federal Business Opportunities (www.fbo.gov)
FFRDC	Federally-funded research and development center
FOUO	For official use only
FOV	Field of view
FRD	Functional requirements document
FTE	Full-time equipment
FY	Fiscal year
G&A	General and administrative
GFE	Government furnished equipment
GFI	Government furnished information

GFR	Government-furnished resources
GFS	Government-furnished services
GOTS	Government off the shelf
H/W	Hardware
HBCU	Historically black colleges or universities
HP	Hydrogen Peroxide
HSAR	Homeland Security Acquisition Regulation
HSPDET	Homeland Security Presidential Directive
HUB	Historically underutilized business
IAA	Interagency agreement
IAW	In accordance with
IBM	International Business Machines
ICD	Interface control document
ILS	Integrated logistics support
IMS	Integrated master schedule
INCOSE	International Council on Systems Engineering
IPA	Isopropyl alcohol
IT	Information technology
IT&E	Independent test and evaluation
KECoM	Knowledge enhanced compressive measurement
LOI	Letter of intent
MEK	Methyl ethyl ketone
MEKP	Methyl ethyl ketone peroxide
MI	Minority institutions MNS
	Material needs statement
MOA	Memorandum of agreement
MOU	Memorandum of understanding
MSE	Mean square error
N/A	Not applicable
NDA	Non-disclosure agreement
ODC	Other direct costs
ORD	Operational requirements document
OSAI	Office of SAFETY Act Implementation
OSARP	On-screen alarm resolution protocol
OSHA	Occupational Safety and Health Administration
OT	Other transactions
OT&E	Operational test and evaluation
PAC	Post-award conference
PCA	Principle components analysis
Pdet	Probability of detection
PDF	Portable document format
PDR	Preliminary design review
Pfa	Probability of false alarm

PI	Principle investigator
PL	Public law
PM	Program manager
PMMA	poly (methyl methacrylate)
POMDP	Partially observable Markov decision process
PoP	Period of performance
PVC	Poly (vinyl chloride)
QA	Quality assurance
R&D	Research and development
RAM	Reliability, availability, maintainability
RFP	Request for proposals
ROC	Receiver operating characteristic
ROI	Return on investment
ROM	Rough order of magnitude
S/W	Software
SAFETY Act	Support Anti-Terrorism by Fostering Effective Technologies Act of 2002 www.safetyact.gov
SBD	Small disadvantaged business
SBIR	Small business innovation research
SCR	System concept review
SNR	Signal-to-noise ratio
SOW	Statement of work
SSA	Social Security Administration
TBD	To be determined
TIM	Technical interchange meetings
TIN	Taxpayer Identification Number
TRL	Technology readiness level
TSA	Transportation Security Administration
TSL	Transportation Security Laboratory
TSO	Transportation Security Officer
UL	Underwriters Laboratory
WB	Woman-owned business
WBS	Work breakdown structure