



***DEPARTMENT OF HOMELAND SECURITY  
SCIENCE AND TECHNOLOGY DIRECTORATE***

**Apex Border Situational Awareness Program**

***Program Plan***

October 8, 2015

Version 0.1

## Table of Contents

|  |    |
|--|----|
| Section 1: Introduction .....                    | 1  |
| 1.1 Scope .....                                  | 1  |
| 1.2 Purpose .....                                | 1  |
| 1.3 Document Ownership .....                     | 1  |
| 1.4 Document Format .....                        | 1  |
| Section 2: Background .....                      | 2  |
| Section 3: Program Overview .....                | 4  |
| Section 4: Schedule Overview .....               | 5  |
| Section 5: Stakeholder Engagement Strategy ..... | 6  |
| 5.1 Organizational Structure .....               | 6  |
| 5.2 Outreach Strategy .....                      | 6  |
| Section 6: Technical Approach .....              | 8  |
| 6.1 Solution Overview .....                      | 8  |
| 6.2 Spiral Approach Overview .....               | 9  |
| Section 7: Test & Evaluation .....               | 10 |
| 7.1 Success Metrics .....                        | 10 |
| 7.2 Data Collection & Assessment .....           | 10 |
| Section 8: Financials .....                      | 11 |
| 8.1 Budget .....                                 | 11 |
| 8.2 Acquisition Strategy .....                   | 12 |
| Section 9: Transition .....                      | 13 |
| Section 10: Risk .....                           | 15 |

Tables

Table 1: Apex BSA Program Budget (Initial Baseline) ..... 11

Figures

Figure 1: Apex BSA Program Schedule Overview ..... 5

Figure 2: Apex BSA Program Organizational Chart ..... 6

Figure 3: Apex BSA Program Solution Synthesis Process..... 7

Figure 4: Apex BSA Solution Overview Diagram ..... 8

Figure 5: Apex BSA Spiral Approach Overview ..... 9

Figure 6: Apex BSA Program Success Metrics ..... 10

Figure 7: Apex BSA Program Data Collection & Assessment ..... 10

Figure 8: Apex BSA Program Spiral Transition Strategy ..... 14

Change Tracker

| Version | Date      | Change Description |
|---------|-----------|--------------------|
| 0.1     | 10/1/2015 | Initial version    |
|         |           |                    |
|         |           |                    |
|         |           |                    |
|         |           |                    |
|         |           |                    |
|         |           |                    |

## **Section 1: Introduction**

This section provides the scope and purpose of the document along with the ownership and format for the document.

### **1.1 Scope**

The scope of this document covers the activities conducted by DHS Science and Technology Directorate (S&T) for the Apex Border Situational Awareness (Apex BSA) program.

### **1.2 Purpose**

The purpose of this document is to provide additional details to the activities contained within the Integrated Master Schedule (IMS) for the Apex BSA program.

### **1.3 Document Ownership**

This document is owned by the Apex BSA program and any changes to this document should be provided to the program for approval as part of the baseline prior to distribution to other organizations.

### **1.4 Document Format**

This document starts with providing an Introduction and Background, and then presents descriptions of the program activities in accordance with the work breakdown structure defined in the IMS.

## Section 2: Background

U.S. Customs and Border Protection is one of the world's largest law enforcement organizations and is charged with keeping terrorists and their weapons out of the U.S. while facilitating lawful international travel and trade. As the world's first full-service border entity, CBP takes a comprehensive approach to border management and control, combining customs, immigration, border security, and agricultural protection into one coordinated and supportive activity. CBP's mission is to safeguard America's borders thereby protecting the public from dangerous people and materials while enhancing the Nation's global economic competitiveness by enabling legitimate trade and travel. The vision is for CBP to serve as the premier law enforcement agency enhancing the Nation's safety, security, and prosperity through collaboration, innovation, and integration<sup>1</sup>.

The DHS S&T Directorate is the primary research and development organization within the Department. Its primary mission is to strengthen America's security and resiliency by providing knowledge products and innovative technology solutions for the Homeland Security Enterprise. Enabling competencies supporting the execution of this mission include the provision of state-of-the-art technology and innovations, as well as operational process improvements, to its customers and partners.

The Apex BSA program will leverage many existing efforts within DHS. In 2011 the DHS Secretary approved the Arizona Technology Plan which identified a mix of technologies, tailored based on cost-effectiveness, local environment, and operational needs, to address CBP capability gaps. The Arizona Technology Plan was implemented through the establishment of programs to deploy fixed towers, mobile sensors, and other technology to improve the detection, identification, classification and tracking of illegal flows within Arizona. The plan was later expanded to encompass the entire southwest border. Another ongoing effort is the Capability Gap Analysis Process (CGAP) initiative being led by the Office of Border Patrol (OBP) to identify capability gaps and mission needs on a sector-by-sector basis and is currently assessing capability gaps across the U.S. Border Patrol. A third effort is the Joint Common Operation Picture (Joint COP) initiative that identified existing and desired data requirements across offices and force levels (i.e. tactical, operational, strategic), to identify where information needs can be satisfied by sharing existing data between offices and where new data sources would need to be acquired. CBP has reiterated its desire for proven, cost effective commercial-off-the-shelf (COTS) solutions rather than "bleeding edge" technology.

While previous acquisition programs and CBP gap filler efforts focused on acquiring resources, A new risk-based strategy has emerged across DHS to focus on a better understanding of the highest risks through intelligence-driven operations so those resources could be prioritized and applied to the areas/domains of highest risk. This strategic shift to a risk-based, intelligence-driven approach to border security stemmed from an environment of growing fiscal constraint and an understanding that reducing border security risk to zero is not feasible. The goal of this new strategy is to have situational awareness of cross border activity so resources can be positioned to detect, identify and respond to high risk areas. This risk-based approach is reflected in the 2014 Quadrennial Homeland Security Review (QHSR), CBP

---

<sup>1</sup> <http://www.cbp.gov/about>

Commissioner's Priorities and Key Deliverables for Fiscal Year 2015 memorandum, 2012-2016 Border Patrol Strategic Plan, and other DHS strategic planning.

In 2014, DHS Secretary Johnson initiated the Southern Borders and Approaches (SBA) Campaign Plan to bring a “unity of effort” across DHS to address security on the southern border. The SBA Campaign Plan was announced following discussions for the need to “secure the border” as part of immigration reform in Congress and also a surge in Unaccompanied Children (UACs) from countries Other Than Mexico (OTMs) in the Rio Grande Valley (RGV) Sector. The SBA Campaign Plan incorporates the strategic risk-based approach and the need for situational awareness to determine the best allocation of resources to combat the highest risks.

In 2014, S&T created the Apex Border Situational Awareness (Apex BSA) program to improve situational awareness for CBP and partner law enforcement agencies to more effectively and efficiently deploy its resources to the areas of highest risk. The Apex BSA program will work with CBP components to identify, collect and document operational capability needs for greater border situational awareness across its missions. The system architecture will adhere to overarching DHS frameworks, policies and standards to ensure the solution is easily adaptable to other organizations with common requirements.

## Section 3: Program Overview

This section provides an overview of the operational need, program goals, impact, and success end-state. Additional details in both those areas are contained in the ***Program Charter***.

### **Operational Need**

CBP and partner law enforcement agencies (federal, state, local, tribal, international) need improved situational awareness to more effectively and efficiently deploy its resources to the areas of highest risk.

### **Program Goals**

The goal of the Apex BSA program is to improve border situational awareness by establishing an enterprise capability to (1) access more data sources, (2) make available decision support tools to translate the available data into actionable information and intelligence, and (3) share that actionable information and intelligence with partner law enforcement agencies.

### **Impact**

The Apex BSA program will enable the Homeland Security Enterprise to achieve increased border situational awareness leading to increased border incursion detection, interdictions, and deterrence.

The measures of effectiveness (MOEs) were derived from the Impact statement to define specific areas of assessment to determine if achieving the program goals had the anticipated impact. The measures of effectiveness are as follows:

- ***Improved measurement of border illegal activity*** to understand current state
- ***Improved assessment of risks*** by identifying current threats along with emerging patterns and trends
- ***Improved alignment of resources to risk*** for current and future operations on both a tactical and strategic level

### **Program Success**

Program success is transitioning an adaptable capability to border operations that has been demonstrated to improve situational awareness of risks and alignment of resources against those risks at the tactical, operational, and strategic levels.

## Section 4: Schedule Overview

This section provides an overview of the milestones and timeline for the program. Additional details in both those areas are contained in the **Integrated Master Schedule (IMS)** and **Work Breakdown Structure (WBS)**.

The program is planned to span FY15-20 to execute three spirals which deliver solutions for transition every eighteen months following the initial program planning. The activities for the program along with the timeline are reflected in the figure below.

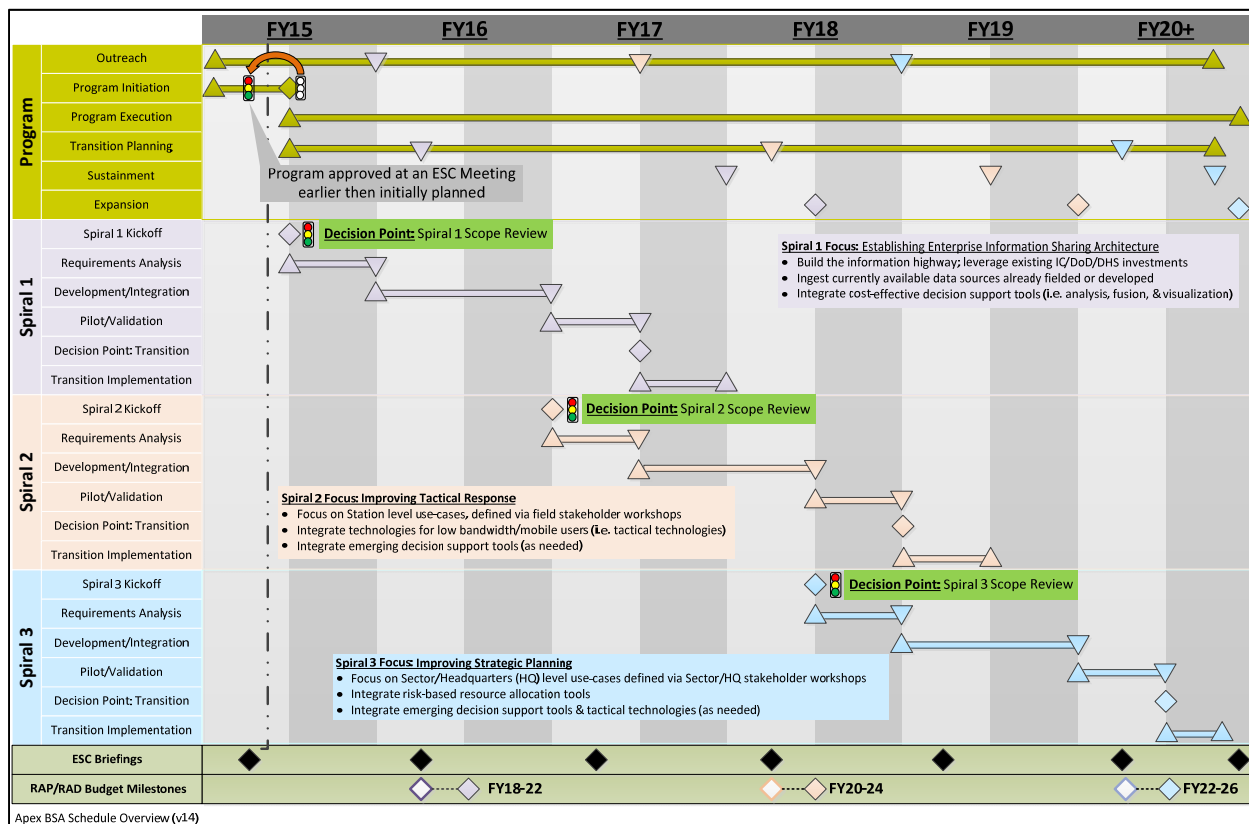


Figure 1: Apex BSA Program Schedule Overview

The program has activities conducted as level of effort (LOE) tasks throughout the program (i.e. Outreach, Program Initiation, Program Execution, Transition Planning) along with milestones for transition (i.e. Sustainment, Expansion, RAP/RAD Budget Milestones).

The program also has discrete efforts (i.e. Spiral Kickoff, Requirements Analysis, Development/Integration, Pilot/Validation, Transition Decision, Transition Implementation) repeated within each spiral to advance the activities from spiral kickoff through transition implementation.



## Section 5: Stakeholder Engagement Strategy

This section provides an overview of the organizational chart and outreach strategy. Additional details in both those areas are contained in the **Outreach Plan**.

### 5.1 Organizational Structure

The organizational structure is strategically staffed with personnel from partner offices within CBP. The program is executed through three integrated product teams (IPTs) with key stakeholders from across the federal government, other law enforcement agencies, and the Homeland Security Industrial Base engaged through those IPTs. The organizational structure is captured in the figure below and reflects the following IPTs:

- Operational IPT
- Technical IPT
- Acquisition/Transition IPT

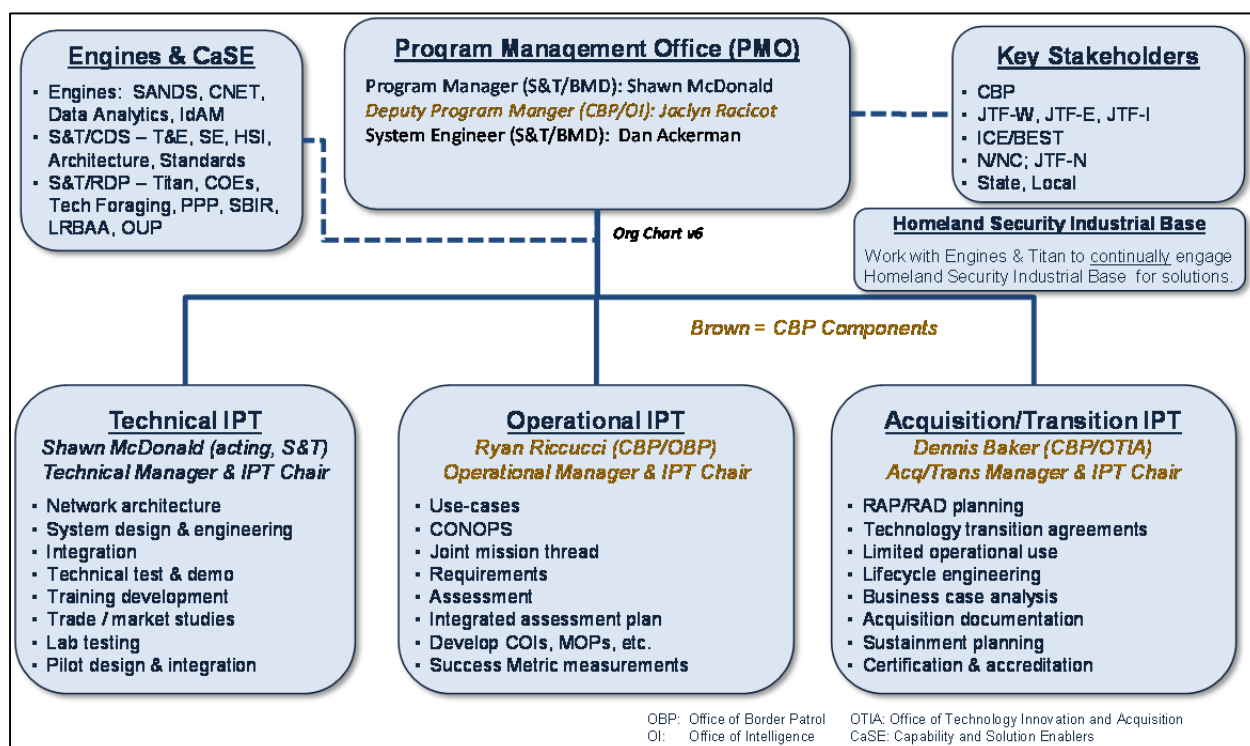


Figure 2: Apex BSA Program Organizational Chart

### 5.2 Outreach Strategy

The outreach strategy for the program is to leverage existing efforts and relationships already within S&T, CBP, and across DHS. The figure below depicts the strategy which highlights the overall process to have a continuous feedback loop between end users' requirements and solution providers which enables the two stakeholder sets to understand each other's efforts and adjust accordingly to realize cost-effective solutions applicable to an extended user base.

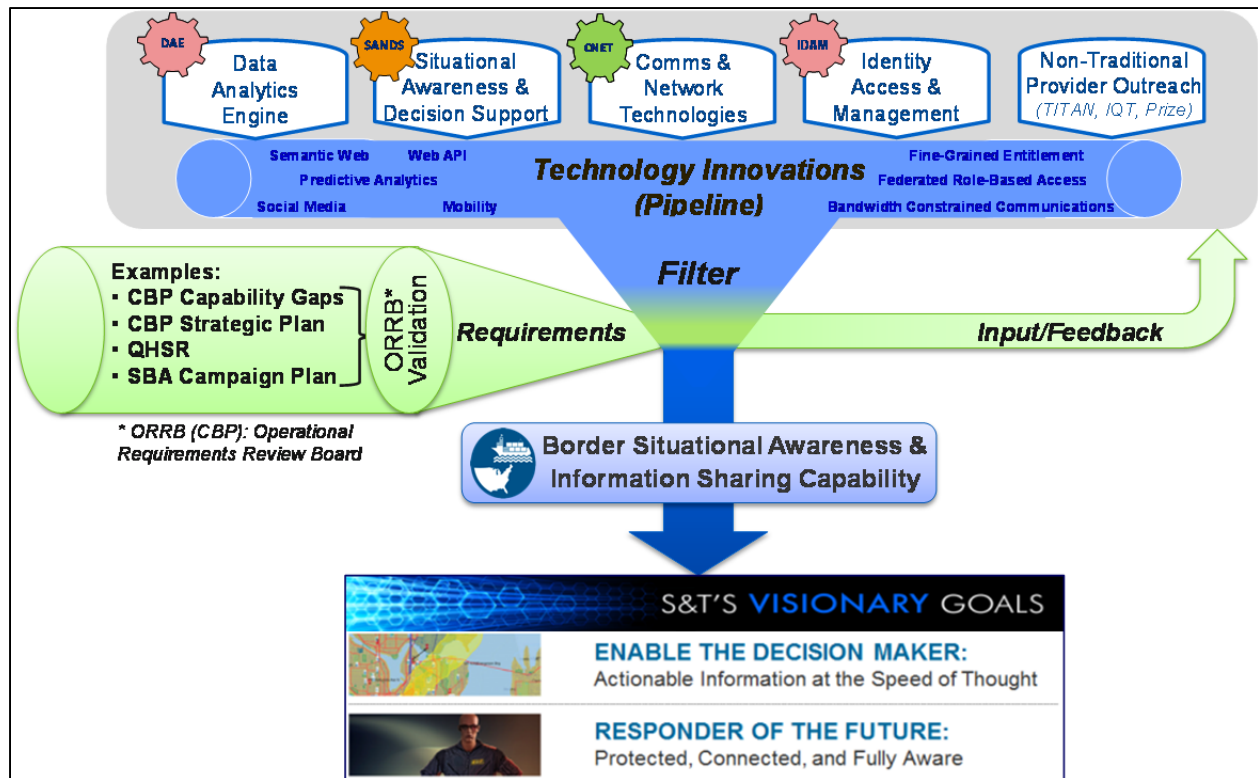


Figure 3: Apex BSA Program Solution Synthesis Process

S&T has stood up several Technology Engines (i.e. Data Analytics Engine, Situational Awareness & Decision Support Engine, Communications & Network Technology Engine, Identity & Access Management Engine) and Public-Private Partnership offices to facilitate the communication between solution providers and programs working with end users to define and address their requirements sets.

## Section 6: Technical Approach

This section provides an overview of the solution and spiral development strategy for the program. Additional details in both those areas are contained in the **Technology Plan**.

### 6.1 Solution Overview

The program is establishing a federated enterprise information sharing architecture for data sharing and decision support tools for cross-organizational collaboration that is cost effective and adaptable for current and future technologies. As shown in the figure below, the program is focused on technologies with a nexus to the land domain which are interoperable with other data sources and decision support tools.

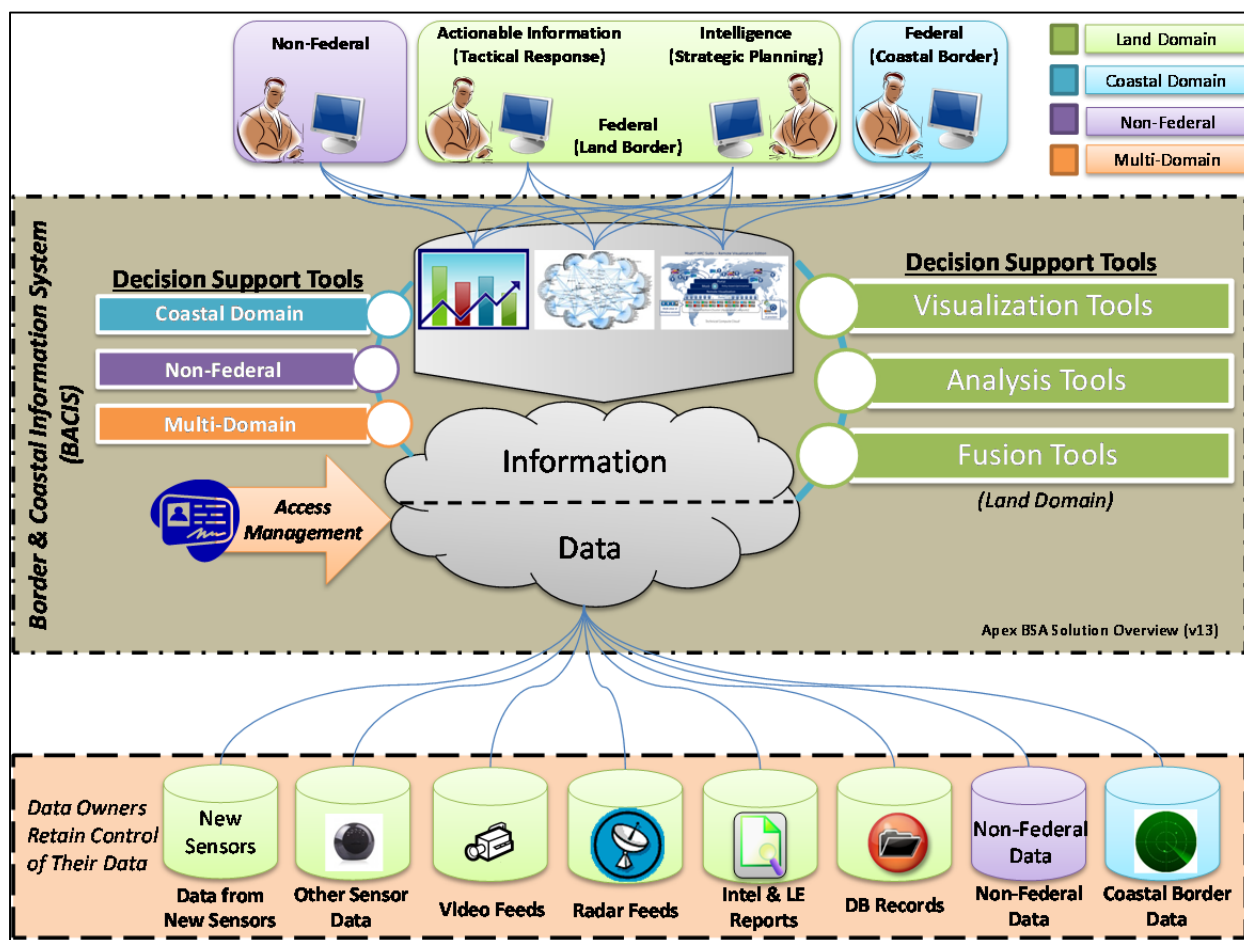


Figure 4: Apex BSA Solution Overview Diagram

The core technology is being leveraged from an S&T coastal situational awareness project, reducing the lifecycle cost and risk while also enabling information sharing across border domains (i.e. land, coastal).

The program is pursuing a mix of government-of-the-shelf (GOTS) and Homeland Security Industrial Base decision support tools as a risk pooling strategy that manages cost and ensures some capability is delivered while also making some investments in innovative, higher risk technologies.

## 6.2 Spiral Approach Overview

The program is executed through three spirals, with a re-evaluation of the end users' priorities prior to each spiral and re-validation of the scope at each spiral kickoff. The focus and timeline for each spiral is shown in the figure below.

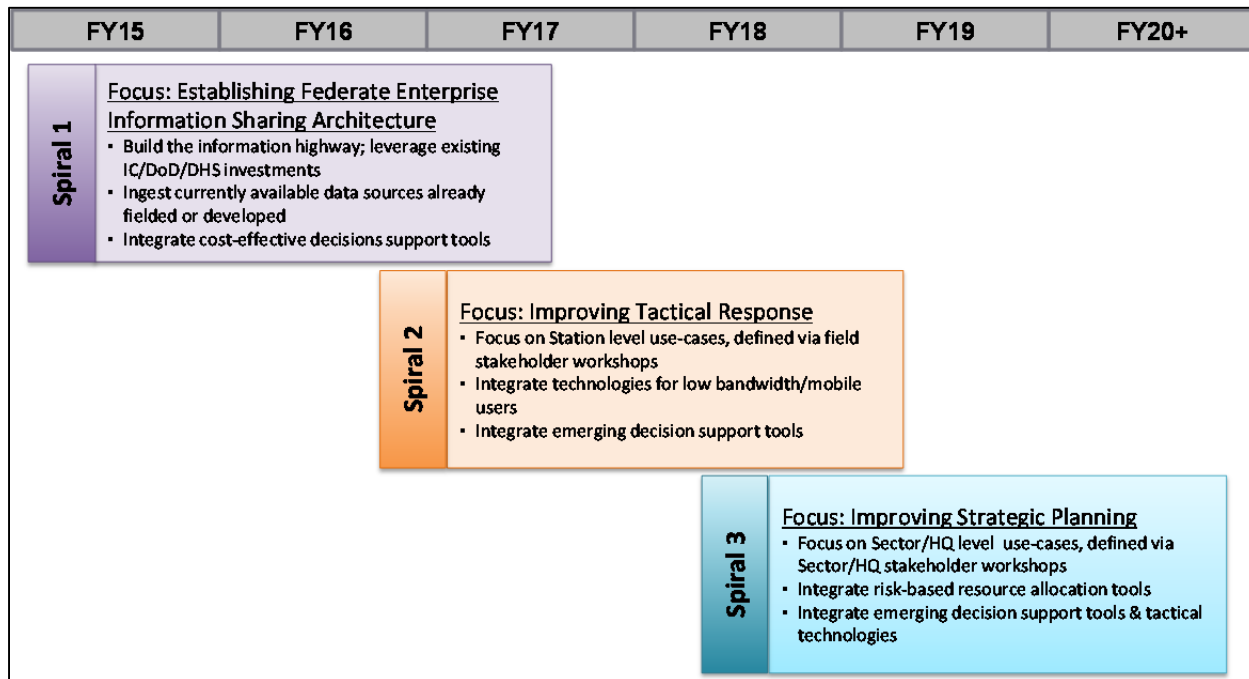


Figure 5: Apex BSA Spiral Approach Overview

Each spiral has a focus the majority of the use cases will address; however flexibility built in to allow other use cases not addressing focus area to be included for proof of concept evaluations (rather than formal operational assessments)

## Section 7: Test & Evaluation

This section provides an overview of the success metrics and strategy for collecting and analyzing data associated with those metrics. Additional details in both those areas are contained in the **Test & Evaluation Master Plan (TEMP)**.

### 7.1 Success Metrics

The program goals and success criteria were decomposed into three areas for metrics for data to be collected and analyzed to assess the performance of the solution provided by the program. The metrics are decomposed into specific data elements, as shown in the figure below.

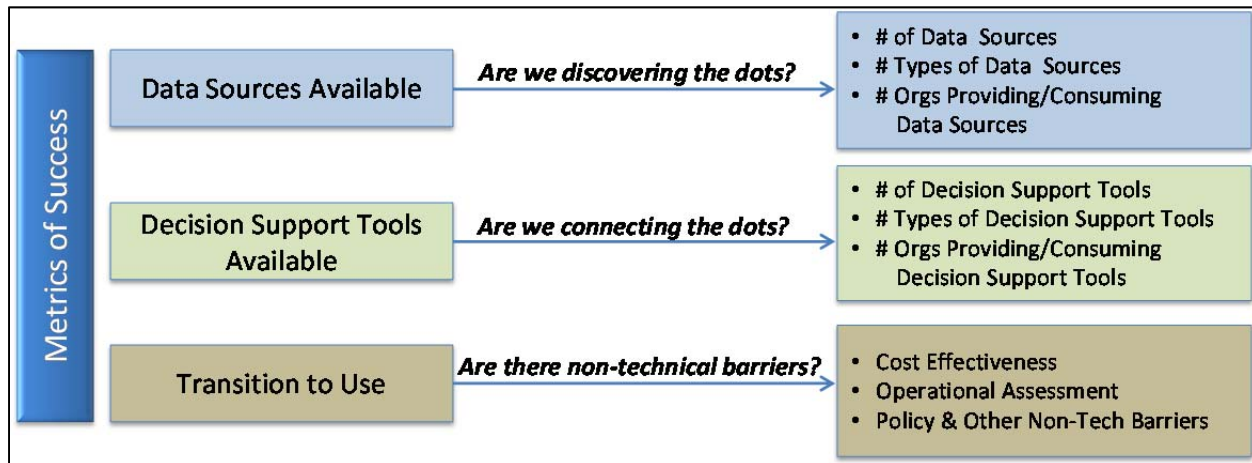


Figure 6: Apex BSA Program Success Metrics

The Data Sources Available and Decision Support Tools Available are meant to provide early indicators during lab testing and technology demonstrations of anticipated utility while Transition to Use is measured largely during operational pilots.

### 7.2 Data Collection & Assessment

The program is collecting data needed to assess the success metrics of the program and reduce the risk of not proving utility throughout the program's activities. The type of testing and test objective is dependent upon the activity the testing is occurring in, as shown in the figure below.

| Activity    | T&E is conducted to achieve specific objectives throughout activities of each spiral  |   |   |
|-------------|---|---|---|
|             | Requirements Analysis   | Development/Integration   | Pilot/Validation  |
| T&E Efforts | Lab Testing   | Technology Demonstrations   | Operational Pilot   |
|             | <ul style="list-style-type: none"><li>Identify &amp; analyze alternatives to "discover &amp; connect the dots"</li><li>Receive early feedback from users on utility of alternatives</li></ul> | <ul style="list-style-type: none"><li>Verify ability of integrated solution to "discover &amp; connect the dots"</li><li>Document feedback from users on utility so modifications can be made</li></ul> | <ul style="list-style-type: none"><li>Validate solution works in the field</li><li>Assess utility to inform transition decision and areas of future spiral development investment</li></ul> |

Figure 7: Apex BSA Program Data Collection & Assessment

Specific test plans will be generated for each of the test events defining the scope, resources, and test objectives for each specific piece of technology or group of integrated technologies is defined.

## Section 8: Financials

This section provides an overview of the budget and acquisition strategy for the program. Additional details in both those areas are contained in the **Resource Plan**.

### 8.1 Budget

The initial budget was developed for the program was based on the activities defined in the Work Breakdown Structure (WBS) which was developed based on the Integrated Master Schedule (IMS). That initial baseline budget is reflected in the figure below and will be designated as “the program budget” unless scope or fiscal considerations change drastically enough to warrant a “re-baselining” of the program at which point a new baseline budget will be generated and displayed below, along with the change from the original baseline budget.

| Discreet Efforts in Each Spiral         | LOE throughout Program            | Activity                   | Task                                     | FY15    | FY16    | FY17    | FY18    | FY19    | FY20     | TOTAL |         |
|---|-----------------------------------|----------------------------|--|---------|---------|---------|---------|---------|----------|-------|---------|
|   |                                   |                            |  |         |         |         |         |         |          |       |         |
|   |                                   | Outreach                   | ICE Coordination                         |         | \$50    | \$50    | \$50    | \$50    | \$50     |       | \$250   |
|   |                                   |                            | USCG Coordination                        |         | \$50    | \$50    | \$50    | \$50    | \$50     |       | \$250   |
|   |                                   |                            | Outreach (Total)                         |         | \$100   | \$100   | \$100   | \$100   | \$100    | \$0   | \$500   |
|   |                                   | Program Management         | Operational IPT Lead                     |         | \$250   | \$250   | \$250   | \$150   | \$75     | \$400 | \$1,375 |
|   |                                   |                            | System Architecture                      |         | \$250   | \$250   | \$250   | \$250   | \$150    |       | \$1,150 |
|   |                                   |                            | Network Architecture                     |         | \$250   | \$250   | \$100   | \$50    | \$50     | \$200 | \$900   |
|   |                                   |                            | Project Management (Total)               |         | \$750   | \$750   | \$600   | \$450   | \$275    | \$600 | \$3,425 |
|   |                                   | Transition Planning        | Transition IPT Lead                      |         | \$200   | \$200   | \$200   | \$200   | \$200    | \$400 | \$1,400 |
|   |                                   |                            | Acquisition & Sustainment Planning       |         | \$100   | \$100   | \$100   | \$100   | \$100    |       | \$500   |
|   |                                   |                            | Certification & Accreditation            |         | \$200   | \$800   | \$800   | \$300   | \$100    |       | \$2,200 |
|   |                                   |                            | Transition Planning (Total)              |         | \$500   | \$1,100 | \$1,100 | \$600   | \$400    | \$400 | \$4,100 |
|   |                                   | Requirements Analysis      | Requirements Engineering                 |         | \$150   | \$150   | \$150   | \$100   | \$0      |       | \$550   |
|   |                                   |                            | Operational Analysis                     |         | \$350   | \$350   | \$250   | \$100   | \$100    |       | \$1,150 |
|   |                                   |                            | Requirements Analysis (Total)            |         | \$500   | \$500   | \$400   | \$200   | \$100    | \$0   | \$1,700 |
|   |                                   | Development & Integration  | Enterprise Sharing Solution Modification |         | \$200   | \$700   | \$600   | \$250   | \$100    |       | \$1,850 |
|   |                                   |                            | Decision Support Tools Integration       |         | \$200   | \$900   | \$1,250 | \$650   | \$200    |       | \$3,200 |
|   |                                   |                            | Data Source Integration                  |         | \$100   | \$1,000 | \$750   | \$300   | \$100    |       | \$2,250 |
|   |                                   |                            | Technology Evaluations                   |         | \$350   | \$400   | \$400   | \$400   | \$0      |       | \$1,550 |
| Enterprise Sharing Solution Integration |                                   |                            | \$0                                      | \$800   | \$1,200 | \$600   | \$100   |         | \$2,700  |       |         |
| Hardware for Decision Support Tools     |                                   |                            | \$0                                      | \$600   | \$250   | \$150   | \$0     |         | \$1,000  |       |         |
| Development & Integration (Total)       |                                   |                            | \$850                                    | \$4,400 | \$4,450 | \$2,350 | \$500   | \$0     | \$12,550 |       |         |
| OT&E                                    | Pilot Node Deployment             |                            | \$0                                      | \$600   | \$600   | \$450   | \$300   |         | \$1,950  |       |         |
|   | OT&E Training                     |                            | \$0                                      | \$200   | \$300   | \$400   | \$200   |         | \$1,100  |       |         |
|   | OT&E Independent Assessment       |                            | \$0                                      | \$500   | \$950   | \$850   | \$200   |         | \$2,500  |       |         |
|   | OT&E (Total)                      |                            | \$0                                      | \$1,300 | \$1,850 | \$1,700 | \$700   | \$0     | \$5,550  |       |         |
| Transition Implementation               | Node Transition & Expansion       |                            | \$0                                      | \$0     | \$100   | \$100   | \$100   |         | \$300    |       |         |
|   | Transition Implementation (Total) |                            | \$0                                      | \$0     | \$100   | \$100   | \$100   | \$0     | \$300    |       |         |
| Version: 11DEC2014                      |                                   | Total (Before 7.9% Tax)    | \$2,700                                  | \$8,150 | \$8,600 | \$5,500 | \$2,175 | \$1,000 | \$28,125 |       |         |
|   |                                   | Total (Including 7.9% Tax) | \$2,913                                  | \$8,794 | \$9,279 | \$5,935 | \$2,347 | \$1,079 | \$30,347 |       |         |

Table 1: Apex BSA Program Budget (Initial Baseline)

Every year a new government-wide “budget” is established through the Planning, Programming, Budgeting, and Acquisition (PPBA) cycle with input from specific programs being solicited through the Resource Allocation Plan/Resource Allocation Decision (RAP/RAD) process. Submissions to the RAP/RAD process may vary slightly from the baseline budget based on guidance provided but will not constitute a changing of the program’s baseline budget and will be archived and tracked separately from the baseline budget. However, as mentioned earlier, a significant deviation in the RAP/RAD submission will constitute a “re-baselining” of the program and require additional documentation of the new baseline.

## 8.2 Acquisition Strategy

As indicated in the Technical Approach and Outreach Strategy, the program will engage the full extent of the Homeland Security Industrial Base (HSIB) to evaluate and source solution meeting the operational needs of end users. This includes other government organizations, academia, traditional solution providers, and non-traditional solution providers. Various mechanisms for sourcing and awarding work will be used to field solutions from across the maturity-innovation (i.e. risk-reward) solution spectrum. The acquisition strategy for awarding funding appropriated for the given fiscal year will be captured in the annual Spend Plan generated for the program, which will be archived and tracked separately from the baseline budget.



## Section 9: Transition

This section provides an overview of the transition strategy for the program and individual spirals which comprise the program. Additional details in both those areas are contained in the ***Transition Plan***.

The Apex BSA program transition strategy is to work with existing systems to pilot new technologies which are adopted into those system baselines following transition as part of existing planned “tech refresh” activities, while also working with existing tactical technology programs to provide requirements which inform their existing planned acquisitions.

This transition approach drastically reduces the time, cost, and risk to get capability to end users.

- ***Reduced Transition Time:*** For new technologies implemented as just another “tech refresh” of existing systems, it eliminates the extensive timeline of an acquisition along with reducing the time needed for areas such as security accreditation, training, and planning as they are just another “deltas” to be added to existing baseline documentation/plans like any other tech refresh components. For technologies implemented through an existing acquisition program, the requirements and other related documentation for the acquisition cycle will be available thus eliminating the time to produce them.
- ***Reduced Transition Cost:*** For new technologies implemented as just another “tech refresh” of existing systems, it eliminates costs of an acquisition program along with lowering the cost for areas such as security accreditation, training, and planning as they are just another “deltas” to be added to existing baseline documentation/plans like any other tech refresh components. For technologies implemented through an existing acquisition program, the requirements and other related documentation for the acquisition cycle will be available thus eliminating the cost to produce them.
- ***Reduced Transition Risk:*** In short, both reduced costs and reduced time individual decrease risk so reducing them both drastically reduces the transition risk. In particular, not starting a new acquisition program eliminates the need to start at the beginning of the acquisition cycle and request new funding in an environment of constrained budgets.

The Apex BSA program is generated multiple outputs from the activities it is funding but those which are identified for “transition” in the baseline plan, which was used to build the budget and schedule, can be described as:

- ***Updated Existing CBP System Baselines:*** The Apex BSA program will fund existing CBP systems to adopt a common open architecture enabling a common IdAM framework and for third party decision support tools to “plug in” to the open architecture. The Apex BSA program will also fund existing CBP systems to demonstrate third party decision support tools can “plug in” to the common open architecture and provide cost effective operational utility. The existing CBP system configuration with the common open architecture and third party decision support tools demonstrated will become the operational baseline for those existing CBP systems at transition (if a positive operational assessment and decision to proceed with transition is made).



- **Tactical Technology Acquisition Documentation:** The Apex BSA program will fund demonstration of tactical technology and the “sum is greater than the parts” synergy of integrated multiple technologies into operations. The output of those efforts is the knowledge of the capabilities of tactical technologies which provide the greatest return on investment when assessed against their costs and operational utility, which will be captured in acquisition documentation for those tactical technologies such as requirements documents and business cases.

The Apex BSA program is generated other outputs from the activities it is funding but those are being categorized as “artifacts” which may be provided to one or more organizations to maintain but do not require the level of effort needed for “transition” planning. An example is the documents which define the open architecture being implemented by systems which may be incorporated into the DHS OCIO’s Information Sharing Segment Architecture (ISSA) or the CBP Enterprise Technical Architecture (ETA).

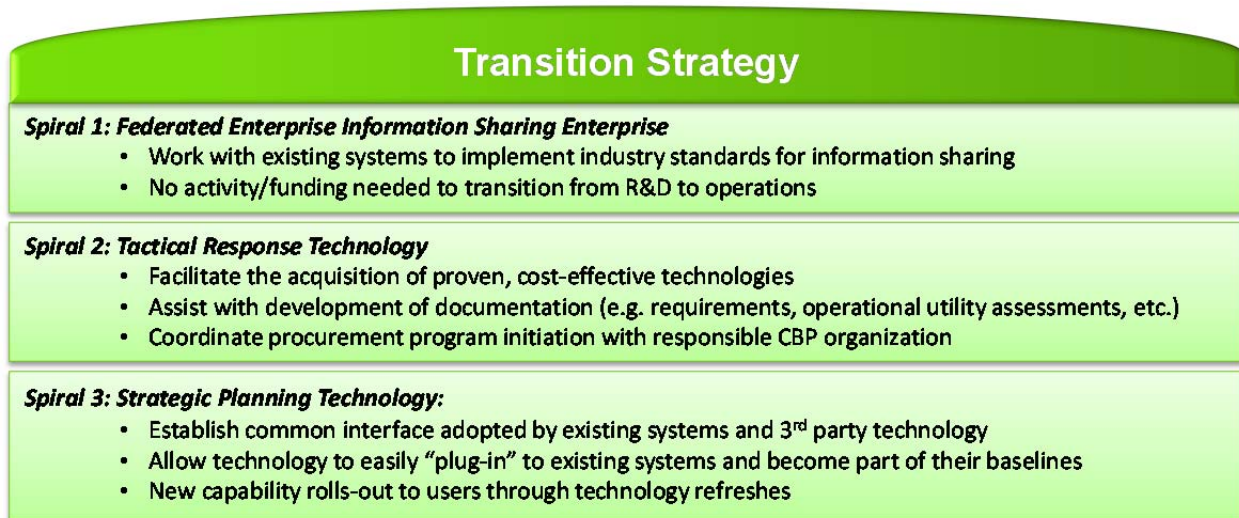


Figure 8: Apex BSA Program Spiral Transition Strategy

The baseline plan, which was used to build the budget and schedule, is to transition all of the demonstrated technologies funded by the Apex BSA program through existing systems and acquisition programs and can be described as:

- **Updated Existing CBP System Baselines:** The updated existing CBP system baselines will be transitioned by the software code loaded and maintained on the production server along with updates to the associated documentation to reflect the new baseline.
- **Tactical Technology Acquisition Documentation:** The tactical technology acquisition documentation will be transitioned by copies of the documents being provided electronically.

## Section 10: Risk

This section provides an overview of the risk approach, risk summary, and risk mitigation efforts. Additional details in all of those areas are contained in the ***Risk Management Plan*** and ***Risk Register***.

A summary of the risk approach strategy is to identify and address risk through IPT structure. Specifically approach is to:

- Document in Risk Register, process defined in Risk Management Plan
- Identify program risks and assess their impact and probability, reviewed and updated monthly (at a minimum) through IPTs
- Prioritize risks based on IPT input and their assessment of impact and probability

A summary of program risk is the program pushed to address challenges beyond the scope and means of the Apex BSA Program. Specifically the risks are:

- Unmanaged expectations of delivering acquisition program level solution (with much larger budget)
- Requirements creep to address every existing capability gap

A summary of the risk mitigation strategy is robust customer engagement and risk pooling. Specifically the approach:

- Ensures continued stakeholder buy-in based on managed expectations and solution meeting needs
- Leveraging existing technologies reduces cost/risk for development and transition
- Risk pooling - Balance portfolio of existing and innovative technology