DEPARTMENT OF HOMELAND SECURITY
SCIENCE AND TECHNOLOGY DIRECTORATE

Project Management Plan (PMP)

Advanced Sensor Analytics Project (ASAP)

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PMP Approvals:

_____	**_____**
Mr. John Thayer **Project Manager**	**Date**
_____	**_____**
Mr. Jonathan McEntee **Director (Acting)** **Borders and Maritime Security Division**	**Date**

Record of Changes

Version	Date	Figure # or Section #	A/M/D*	Description of Change / Rationale
1.0	9/30/2016			First Release
2.0	11/18/2016		M	Incorporated comments from Douglas Lane throughout the document
2.1	3/10/17		A	Incorporated comments from CDF review team

* A-Added, M-Modified, D-Deleted

Contents

1. Project Summary

Currently, the Department of Homeland Security (DHS) and the United States Coast Guard (USCG) do not have sufficient access to surveillance sensors that provide Maritime Domain Awareness (MDA) to support USCG mission needs, nor provide coverage of remote regions. In response, the DHS Science and Technology Directorate (S&T) created The Port and Surveillance Program, with Advanced Sensor Analytics Project (ASAP) a project within the Program, which is a technology demonstration that taps the burgeoning commercial space market and government investments in fusion and analytics, to provide a capability that will enhance MDA across all of the USCG mission space.

The ASAP project consists of 3 subprojects: Polar Scout, Data Analytics, and Arctic Communications.

Polar Scout: Polar Scout involves the identification and development of space-based sensor feeds. The focus is identifying and leveraging existing sensors (both commercial and government) and procuring new sensors to fill MDA gaps. Polar Scout consists of an integrated system of United States Government (USG)-owned sensors (6U CubeSats) and commercial sensors (HE360 CubeSats). These sensors will be tasked to collect maritime data in support of DHS missions. The collected data is fused with weather, Automatic Identification System (AIS), air-tracks and other data to provide the DHS and the USCG with maritime situational awareness. Based on the fused information, the Polar Scout system could then request or gather information (e.g. imagery data) from other established data sources. The information received and fused within Polar Scout is then provided as input to the Data Analytics to perform additional analysis.

- ***Data Analytics***: Data Analytics provides sensor exploitation enhancement of tracking, tipping, and queuing of MDA relevant objects, to support the Coast Guard and other DHS missions. The intent is to ensure that analytics performed will provide S&T with a deeper understanding of commercial space-based data sets and corresponding data correlation, predictive and prescriptive analytics.
- ***Arctic Communications*** - TBD

In this new era, space-based Earth observation and sensing products will be readily available both from *Internal Assets* (i.e., satellites owned and operated by an organization) and from *External Assets* (e.g., from commercial organizations). Organizations that are capable of intelligently requesting, gathering, fusing, and analyzing these products will have a huge advantage over those that can't, and this is the motivation behind this project. Specifically, the two primary purposes of ASAP are 1) to serve as a technology demonstration to guide industry and 2) to determine how to harness the capabilities of these emerging technologies, and leverage the resulting information.

1.1 Background and Purpose

ASAP is focused on the improvement of MDA by enhancing sensor analytical performance for MDA systems, like DHS's Integrated Maritime Domain Enterprise/Coastal Surveillance System (IMDE/CSS) that operate within a multiple data feed/source (multi-source) environment. Multi-source solutions will be accomplished through the use of analytical engines, that will assist DHS teams in target tracking and identification, dynamic information annotation, and achieving a high-level information fusion of multi-source to enhance MDA. Also, ASAP is leveraging government investments made in an In-Q-Tel startup, HawkEye360, Inc (HE360), to provide commercial space-based radio frequency detection. In-Q-Tel is an independent, not-for-profit organization created to bridge the gap between the technology needs of the US Intelligence Community (IC) and emerging commercial innovation.

It is expected that space-based sensors can and will fill many gaps and improve success in the DHS maritime and border mission sets, initial T&E will be on maritime missions such as SAR. DHS currently uses a combination of USCG Search and Rescue Response Regions (SRR), Marine Channels 16 and 60, 406 MHz radio Rescue beacons, Rescue 21, and COSPAS- Search and Rescue Satellite Aided Tracking System (SARSAT) in its search and rescue concept of operations. However, there are limitations to these systems that ASAP addresses. Most of these systems have no or limited Arctic coverage. Also, the coverage for Rescue 21 is limited to close to shore. SARSAT covers a broader range but does not provide persistent (continuous coverage) and sometimes requires multiple passes to geolocate. The next generation SARSAT (MEOSAT) will not be fully operational for ten years.

The ASAP acquisition strategy is based on the following: (1) USCG's need to augment a cost-effective solution for SAR operations; (2) DHS Component operationally relevant space-based information is not available, and (3) the selected approach will provide an initial deployment of operationally useful capabilities by leveraging high technology readiness level (TRL) components to reduce risk to schedule and cost. This is accomplished by procuring high TRL elements and proven performers through Inter Agency Agreements (IAA) to leverage existing contract vehicles at various government agencies. Furthermore, ASAP is working closely with USCG to work through the process to support USCG acquisition plan to support USCG Polar Scout acquisition gates. As part of the DHS S&T and USCG Memorandum of Understanding (MOU), USCG is developing an acquisition plan to support the transition of ASAP capabilities.

1.2 Customers

1.2.1 Polar Scout

USCG is the customer and end-user for this initial Polar Scout mission demonstration. Also, Customs and Border Protection (CBP), DHS Office of Intelligence and Analysis (I&A), and DHS Borders and Maritime Security Division (BMD) can benefit from the ASAP program that leverages smallsat space-based data and analytics. Furthermore, the NOAA's Search and Rescue Satellite Aided Tracking (SARSAT) program has a gap in the Arctic and won't have a solution estimated for another 5 to 10 years.

1.2.2 Data Analytics

Need to updated this section

1.2.3 Arctic Communications

TBD

1.3 Deliverables/Products

1.3.0.1 Polar Scout

The successful execution of this Polar Scout project will result in a Arctic MDA demonstrations that demonstrates SAR missions employing CubeSats to detect and geolocate 406 MHz emergency beacons.

1.3.0.2 Analytics

The Data Analytics project will provide predictive analytics with the ability to process information from various data sources including space-based, airborne, and ground-based. Additionally, ASAP is an open architecture (e.g., open APIs and data models) that will enable rapid integration of these solution components into Components' existing systems across varied DHS missions by leveraging the Integrated Maritime Domain Enterprise (IMDE/CSS) and DOD/J39's Project DataHub.

1.3.0.3 Polar Communications

TBD

1.3.1 Product or Service Descriptions

This project demonstrates the capabilities of a system architecture comprised of small satellites, predictive data analytics, and ground elements to close gaps in MDA. ASAP is a demonstration project and is actively working with DHS components and other agencies to plan for a transfer of capability. ASAP will provide lessons learned, technical interchange meetings with other S&T programs, and investments made by ASAP in Borders and Maritime Security Division (BMD) sponsored technologies (i.e. IMDE/CSS).

1.3.2 Capability or Performance

ASAP provides value to DHS S&T by resulting in (1) a cost-effective solution to augment SAR operations in the Arctic for the USCG; (2) operationally relevant space-based information to DHS Components; and (3) an acquisition approach that provides an initial deployment of operationally useful capabilities by leveraging high TRL components to reduce risk to schedule and cost. Strategic investment will allow DHS to be a provide a demonstration for space-based assets to increase USCG's SAR needs in relevant timeframes.

Add description of the gaps identified below and include the other maritime domain awareness gaps.

ASAP addresses gaps identified in the U.S. Arctic Strategy, DHS/Integrated Product Team (IPT) Reference Number BSM-USCG-16-004 (High), and FY17 USCG RDT&E Congressional Justification. Also, the lack of timely access to space-based data was determined through various meetings with USG officials from the intelligence community.

G-FY16/17-SB-M-4, Secure Borders Secure Borders–Maritime (Joint CBP, USCG) Improve dark vessel detection, tracking and interdiction capabilities. Enhance the capability to reliably and accurately detect, track, classify and interdict small dark vessel threats (including pangas, semi-submersibles, go-fast boats, and other maritime threats).

1.4 Transition Plan

1.4.1 Project Transition

The initial SAR demonstration will be developed and tested in late FY16 through early FY18. This augmented commercial proof-of-concept will be available in mid-to-late FY18 (a) to improve Arctic SAR response times and (b) to provide a transition path to commercial solutions that can augment or gap-fill US Government (USG) space-based sensor systems such as National Oceanic and Atmospheric Administration (NOAA) SARSAT.

The current major transitions that are planned are:

- **USCG**: Once the concepts are proven through the demonstrations, transfer of the EPRIB capabilities – including 6U CubeSats, ground hardware and software, and demonstration software can be transferred to USCG as a prototype. An initial review and discussion of the metrics is underway with the USCG research, design, test, and evaluation (RDT&E) team.. In FY17, the USCG Polar Scout project will provide a detailed review and update of the metrics based on additional input from USCG operational groups and ongoing discussions with NOAA's SARSAT team. Subsequently, USCG RDC will lead T&E for the ASAP SAR demonstration.
- **NOAA SARSAT:** Initial deployment of the next-generation Medium Earth Orbit Search and Rescue (MEOSAR) satellites continues to be delayed because it is a secondary payload on GPS Block III program. A single MEOSAR only orbits the earth twice per day. Presently contracts have only been awarded for eight MEOSARs. The full constellation of 24 necessary for persistent coverage is 5-10 years away. NOAA SARSAT views ASAP as a gap filler until MEOSAR constellation is in place. ASAP continues to work with SARSAT to understand the operational standards and processes to interface with existing SARSAT system and possibly transition this system to operations as an additional SARSAT asset.

1.5 Schedule and Budget Summary

The current cost of the project is $19.3M over a three-year period. DHS S&T and USCG have partnered with the National Reconnaissance Office (NRO) Mission Integration Directorate's

(MID) CubeSat Office, the USAF Operationally Responsive Space (ORS) Office, United States Navy Program Executive Office (PEO) Space Systems, and the Department of Defense (DoD) J39 (Global Operations) Office. These relationships allow this project to:

- Leverage over $50M of Non-recurring Engineering (NRE) by the IC and DoD for both USG and commercial systems,
- Leverage over $15M FY16 RDT&E investment by these organizations,
- Continue leveraging IC and DoD investment to ensure Homeland Security needs can be met by emerging USG and commercial solutions.

1.5.1 Project Schedule and Budget Summary

The following list provides tasks by funding year denoting funding. See section 4.4 for more detail.

Funding Source	FY16	FY17	FY18	Total
Internal (S&T)	$12M	$2M	$5.3M	$19.3M

Table 1: Budget Source Summary

1.6 Project Organization

NOTE: Update below tables

1.6.1 Polar Scout

Role	Responsibility	Organization
Funds	Provide adequate funding for ASAP	DHS S&T
Program Manager	Overall leadership of ASAP	Homeland Security Advanced Research Projects Agency (HSARPA) BMD
Program Champion	ASAP Program advocate	USCG DCO-D
Operational Advocate and Transition Partner		USCG CG-7 (Assistant Commandant for Capability)

Test and Evaluation Lead		USCG CG-926 (Office of RDT&E)
Ground Station Lead	Build and integrate 2 MC3 compatible terminals into the MC3 network	USCG Research and Development Centers (RDC)
User Operations and SAR Requirements	USCG CG-926	Coast Guard Liaison
Polar Scout	Polar Scout Lead	DHS
CubeSat Provider	Provide ORS 6U	AFSPC SMC/ADE
Systems Engineering	End-to-End ASAP Systems Engineering	Aerospace Corp
Ground Station Provider	Provide Mobile CubeSat Command and Control (C2)	Naval Postgraduate School

Table 2: Polar Scout Project Organization

1.6.2 Analytics

Role	Responsibility	Organization
Funds	Provide adequate funding for ASAP	DHS S&T
Program Manager	Overall leadership of ASAP	Homeland Security Advanced Research Projects Agency (HSARPA) BMD
Program Champion	ASAP Program advocate	USCG DCO-D
Test Bed Provider / Analytics Tool Review	Provide IMDE	IMDE
ASAP Integration via IMDE/CSS		S&T/BMD
Systems Engineering	End-to-End ASAP Systems Engineering	Aerospace Corp
Analytics Partner	Provide DataHub capabilities	Joint Staff J39
Analytics Partner	Provide Data Sources and Data Analytics capabilities	IQT
Contracting Officer for Data Analytics Contract	Provide Data Analytics Capability	NSWC Crane
ASAP Analytics Prime Contractor via NSWC Crane	Develop ASAP Analytics Capabilities	HumanGEO/RadiantBlue

Table 3: Analytics Project Organization

1.6.3 Arctic Communications

Role	Responsibility	Organization
Funds	Provide adequate funding for ASAP	DHS S&T
Program Manager	Overall leadership of ASAP	Homeland Security Advanced Research Projects Agency (HSARPA) BMD
Program Champion	ASAP Program advocate	USCG DCO-D
TBD	TBD	TBD

Table 4: Arctic Communications Project Organization

1.6.4 Stakeholder dependencies

This section describes the dependencies among the stakeholders. For example, NOAA and Coast beacons are needed for payload characterization for both HE360 and the 6U CubeSats. The analytics effort is also dependent on Datahub products. (NOTE: Add prose to describe the dependencies).

1.6.5 Project Personnel

Note: Update below tables

Name	Organization	Title/Role	Email	Phone
John Thayer	DHS S&T/HSARPA/BMD	Project Manager		
Alan Arsenault	RDC	C4ISR Branch Chief		
LCDR Sam Nassar	RDC	Polar Scout Project Lead		
LCDR Jehu	CG-761			
Holly Wendelin	CG-926	C4ISR Domain Lead		
LT Joe Ferdinando	CG-2	Coast Guard Liaison to NRO		
RADM Linda Fagan	DCO-D	Program Champion		
Lt Matthew Hamilton	AFSPC SMC/ADE	ORS 6U	matthew.hamilton.21@us.af.mil	(505) 846-9987
Capt Jason Ziburski	AFSPC SMC/SDDS	ORS 6U	jason.ziburski@us.af.mil	505-846-2202
Shawn McDonald	DHS S&T	IMDE/CSS	Shawn.McDonald@hq.dhs.gov	202-254-5879
John Herbert	DHS S&T	IMDE/CSS	John.Herbert@associates.hq.dhs.gov	202-254-8743
John Paul	Aerospace	On-site support & Aerospace task lead	John.g.paul@aero.org	
Diana Webber	Aerospace	Mission Systems Engineering		
Margherita Eastman	Aerospace	Mission Systems Engineering		

Allison Taylor	Aerospace	Mission Systems Engineering		
Camille Keely	Aerospace	Mission Systems Engineering		
Sasirekha Tumuluri	Aerospace	Mission Systems Engineering		
Bradley Hartman	Aerospace	Mission Systems Engineering		
Jeff Welsh	Applied Minds	6U Bus- Digital Assurance	jwelsh@appliedminds.com	
Vincent Riot	Lawrence Livermore National Laboratory	I&T, C&C	riot1@llnl.gov	
George Moretti	Millennium Engineering and Integration (MEI) Company	6U Bus Development	gmoretti@meicompany.com	
Damon Wong	NRO	Launch Integration		
Daniel Cheeseman	Raytheon Missile Systems	6U Bus Hardware Integration and Test	Daniel_F_Cheeseman@raytheon.com	
Ervin Frazier	Rincon Research Corp.	Mission Systems Engineering, 6U Payload Development, I&T, Ground planning and processing, Payload Operations	erf@rincon.com	
Jim Perry	Space Dynamics Laboratory	6U Bus Design	jim.perry@sdl.usu.edu	

Table 5: Polar Scout Project Personnel

Name	Organization	Title/Role	Email	Phone
John Thayer	DHS S&T/HSARPA/BMD	Project Manager		
Shawn McDonald	DHS S&T	IMDE/CSS	Shawn.McDonald@hq.dhs.gov	202-254-5879
John Herbert	DHS S&T	IMDE/CSS	John.Herbert@associates.hq.dhs.gov	202-254-8743
John Paul	Aerospace	On-site support & Aerospace task lead	John.g.paul@aero.org	
Diana Webber	Aerospace	Mission Systems Engineering		
Margherita Eastman	Aerospace	Mission Systems Engineering		
Allison Taylor	Aerospace	Mission Systems Engineering		
Camille Keely	Aerospace	Mission Systems Engineering		
Sasirekha Tumuluri	Aerospace	Mission Systems Engineering		

Bradley Hartman	Aerospace	Mission Systems Engineering		
Ervin Frazier	Rincon Research Corp.	Provide Receive tasking and process EPIRB data for Analytics Project	erf@rincon.com	

Table 6: Analytics Project Personnel

Name	Organization	Title/Role	Email	Phone
John Thayer	DHS S&T/HSARPA/BMD	Project Manager		
John Paul	Aerospace	On-site support & Aerospace task lead	John.g.paul@aero.org	
Diana Webber	Aerospace	Mission Systems Engineering		
Margherita Eastman	Aerospace	Mission Systems Engineering		
Allison Taylor	Aerospace	Mission Systems Engineering		
Camille Keely	Aerospace	Mission Systems Engineering		
Sasirekha Tumuluri	Aerospace	Mission Systems Engineering		
Bradley Hartman	Aerospace	Mission Systems Engineering		
TBD				

Table 7: Arctic Communications Project Personnel

1.6.6 Internal Structure

Update this section to remove 3U contractors (e.g. NPS). Update this section to include the internal structure for the analytics and another for artic communications.

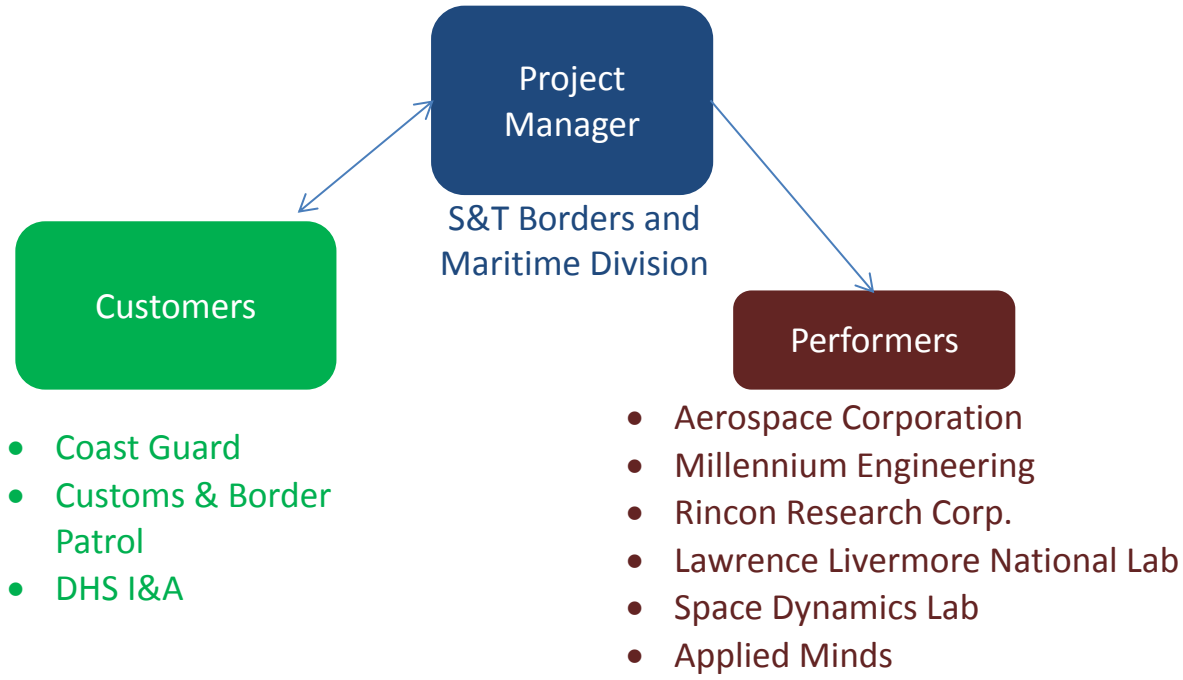

Figure 1: Polar Scout Internal Project Structure (Update Figure)

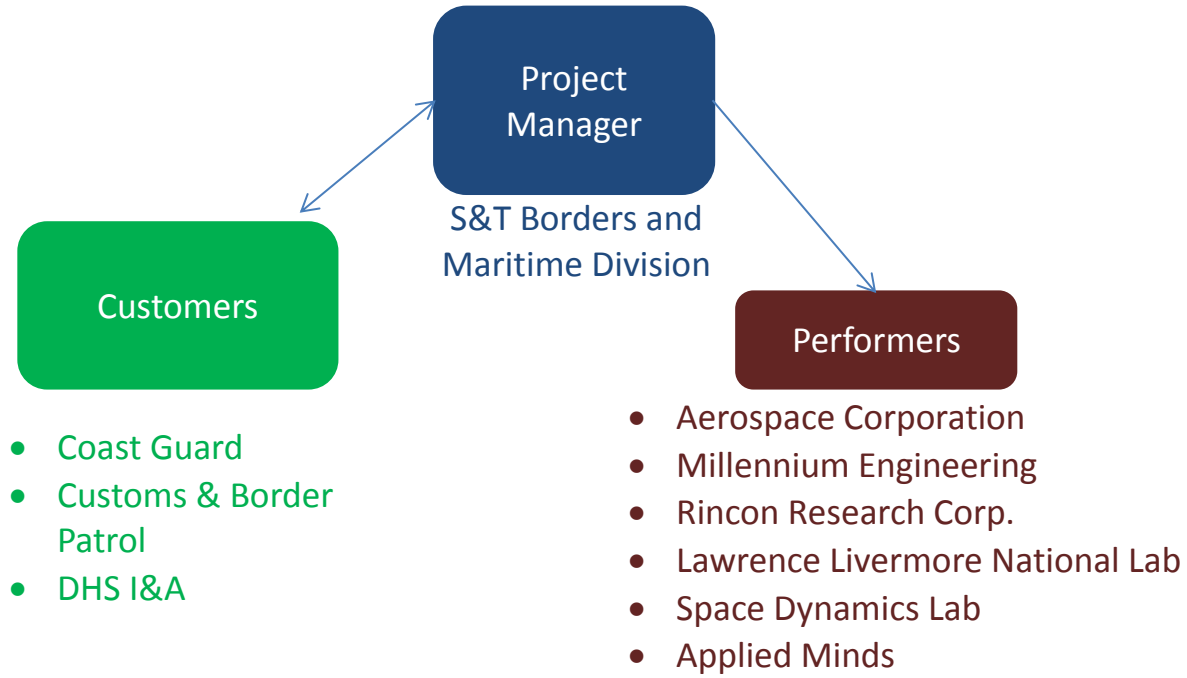

Figure 2: Analytics Internal Project Structure (Update above figure)

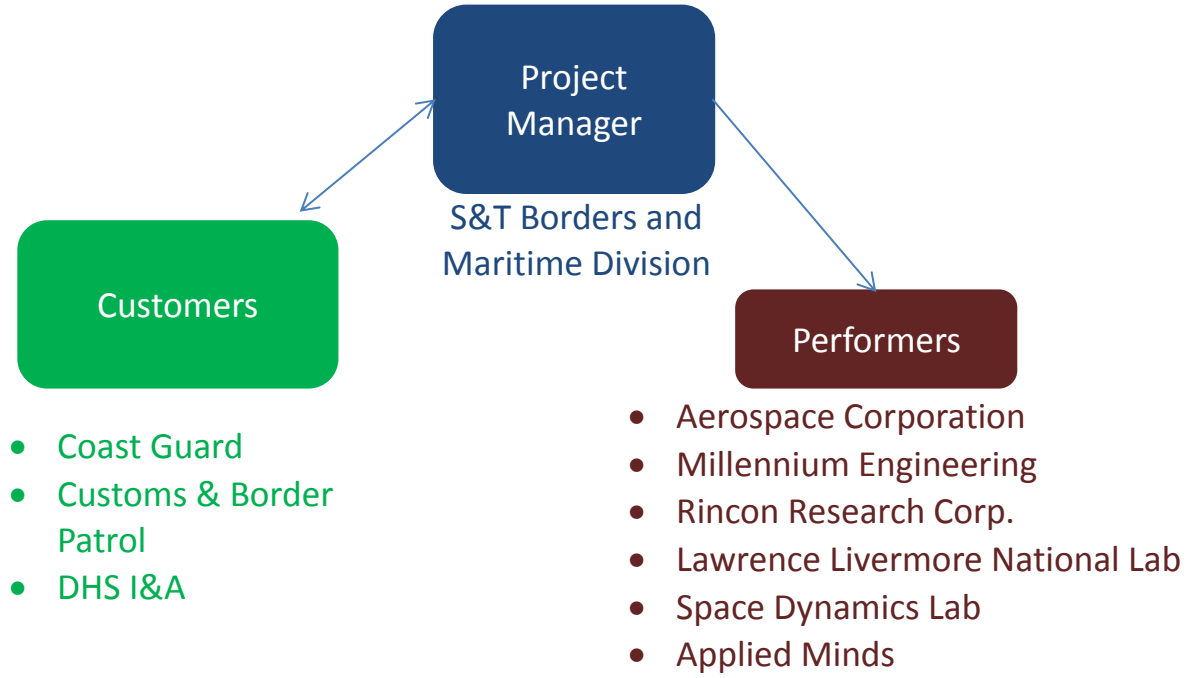

Figure 3: Arctic Communications Project Structure (TBD)

1.7 Benefits to S&T

ASAP is a deomonstration for commercial space data combined with data analytics, initially to support the Coast Guard. ASAP will provide S&T with a deeper understanding of

commercial space-based data sets and the corresponding data analytics that can support many of the component's missions.

1.7.1 New Capabilities / Technology

The successful execution of this project will result in improved MDA resulting in increased reaction time for SAR operations, ultimately leading to an increased number of saved lives at a reduced total cost of ownership.

1.7.2 New Intellectual Property

This project leverages multiple USG investments (e.g., MID 3U and ORS 6U designs) which are government-owned IP or government-purpose rights. All new IP generated by this project likewise will be government-owned or government-purpose rights.

1.7.3 Public Access of Federally Funded Scientific Research

At this time ASAP management does not intend on pursuing publishing via peer-reviewed journal works related to ASAP. However, if that changes, ASAP management will execute the DHS S&T policies to ensure that their cleared and published peer-reviewed journal articles to the public.

1.7.4 Data Management

A data management plan is necessary for this project. For now, the plan and associated data will be posted in ASAP's project folder located on S&T internal share drive ("\\DHSnet.ds1.dhs\s&t_shares\Borders and Maritime\").

1.7.5 Other Benefits

In addition to the USCG applicability, ASAP provides other benefits to the private sector, government, and academic/researchers.

- **Government:** ASAP identifies USCG MDA gaps and addresses these deficiencies by developing a system that will ingest existing data sources, build new sensors/sources where none currently exist and synchronize data for collaborative analysis and improved situational awareness at multiple echelons. This work is also directly applicable to the S&T/BMD.
- **Private sector:** ASAP will establish an open ecosystem, allowing sensors, ground processing, and analytics to operate in a modular way, by developing an open architecture, open APIs, and an open data model. The ASAP processing node will maintain a set of interfaces (APIs) that are meant to ensure interoperability between data systems across the various suite of sensors and sensor types. The open framework will consist of standards for three different levels: Infrastructure Services, Common Services, and Mission Services. ASAP leadership believes this openness will lower the barrier to commercial entry and enable the ASAP software to interoperate with other components' existing systems.
- **Academic/researchers:** The academic/research community will benefit from ASAP's open architecture by providing entry points for innovative solutions at the infrastructure, shared, and mission processing levels. Also, ASAP will provide a

roadmap for a transition from demonstration to prototype, further reducing acquisition timelines to bring capabilities to enhance MDA.

1.8 Assumptions

1.8.1 External Dependencies

This project has various external dependencies. This project makes use of many project elements by leveraging available components available from internal and external organizations. The availability of these elements is a fundamental assumption for the ASAP project. The external dependencies are summarized in the tables below:

1.8.2 Polar Scout

Project Element	Provided by	Agreement	Description
6U CubeSat Bus	ORS	IAA and MOU	ORS has a 6U bus available that they are providing to ASAP
6U Ground Terminals	Naval Post Graduate School (NPS)	IAA	NPS is developing 6U Ground Terminals that will be made available for use by ASAP
Operations	Coast Guard RDT&E	IAA and MOU	CG will provide operations and testing support to ASAP. DHS S&T has an existing MOU with CG RDT&E.
Project DataHub	DoD/J39	TBD	J39 offered to provide all source to DHS. In initial discussions to development MOU.
Launch	NRO	N/A	NRO will provide the launch for the 6U CubeSats
IMDE/CSS	DHS S&T	N/A	IMDE/CSS is an enterprise system of maritime nodes providing streams of near real-time sensor data and access to non-sensor data including information, analysis, and archives. This system will access, process, and fuse data from mission feeds and make it available through a web-based portal to system users. For the initial demonstration Polar Scout will not utilize IMDE. .

Table 8: External Dependencies

1.8.3 Data Analytics

Project Element	Provided by	Agreement	Description
DataHub	DoD/J39		Provide DataHub software for the ASAP Analytics to leverage

1.8.4 Arctic Communications

Project Element	Provided by	Agreement	Description
TBD			

1.8.2 Human Factors

Human factors will be a consideration for all areas that have human factors requirements. The Human factors approach is to work with impacted stakeholders and development contractors to ensure that applicable human factors requirements and standards are included in the final design. End users and stakeholders will be involved in the design, test and evaluation of the HSI. End users will participate in the hands-on testing. As needed, other HSI SMEs will be utilized to ensure the appropriate HSI requirements are addressed.

1.8.3 Cyber

1.8.3.1 Polar Scout

Polar Scout will interface with the MC3 network to send and receive data from the CubeSats using the existing MC3 accredited network. The Polar Scout Mission Operations Center (MOC) and the Spacecraft Operations Center (SOC) will interface with the MC3 network to request, plan, task, command and receive data from the CubeSats. Polar Scout will ensure the interface to the MC3 network is secure via the SATRN client interface.

1.8.3.2 Analytics

The ASAP Analytics elements will operate on GovCloud, which has been FedRAMP accredited, and will not initially interface with any DHS or Coast Guard internal networks. The ASAP Analytics project will adhere to the GovCloud information assurance requirements. The ASAP Analytics contractor currently develops and operates on GovCloud for other government projects. As the Analytics project transitions onto IMDE, the project will abide by IMDE security protocols and posture. Security infrastructure will follow guidelines set forth by the IMDE system which is already an accredited entity. The IMDE system will dictate data traffic, data sources, and data storage standards.

DataHub will incorporate a high level roadmap which will tie closely to the goals of the program, bringing together the appropriate data sources to provide a solution to the data analytics problem. The source systems might change due to our dependency on vendors and vendor readiness. Data source systems will be constantly evaluated to maintain continuity of data flow and coverage to accomplish the necessary analytics. Each data source will be evaluated for its ability to offer data clarity and the volume necessary to perform accurate analytics. The team will properly design data models which can be easily interpreted and utilized by all downstream and dependent systems. As part of the technology readiness of the ASAP system, new tools and technology will evaluated and incorporated as needed to make sure the most relevant and up to date tools are used. The team will conduct periodic technology inventory and evaluations of new resources as part of an assessment process which will serve as a roadmap for technology. The assessment will include compatibility with current tools and platforms being used to reduce disruption and barriers to existing systems. New data sources that are added to the ASAP system will also follow the same evaluation methodology.

The Datahub portion of the ASAP analytics will have controlled access and will only access data from trusted and authenticated sources.

All contractors will be required to follow requirements, ICDs and standards of GovCloud to ensure compliance with cyber requirements and regulations.

1.8.4 Non-traditional Stakeholders

1.8.4.1 Encryption

The Polar Scout project and data is unclassified, however the system will incorporate AES-256 encryption in the space to ground link. The data is encrypted prior to entering the MC3 network and decrypted upon receipt by the Polar Scout system.

1.8.4.2 508 Compliance

All web facing accessible interfaces will be 508 compliant as appropriate for a demonstration system.

2. Requirements

2.1 Requirements Management Plan

The requirements set was created with customer input. This section will be continually updated throughout the project with key stakeholder involvement and input.

2.1.1 Test and Evaluation

2.1.1.1 Polar Scout

The Polar Scout test and demonstration strategy is depicted in the figure below. Once the 6U and HE360 vehicles are launch, it will take approximately 1 week (for the HE360 vehicles

to approximately 4 weeks (for the 6U CubeSats) to locate and make initial contact. Once the vehicles are located, both systems will perform bus initialization activities for approximately 30 days. Once the bus initialization activities are complete, payload initialization activities will commence and span for a period of approximately 2 weeks. Once the payloads have been initialized, NOAA and Coast Guard test beacons and reference beacons will be scheduled and or deployed to support the payload characterization activities. Through the Test and Evaluation Working Group (which includes spacecraft contractors, NOAA, Coast Guard, and other stakeholders), the appropriate test and reference beacons will be scheduled and deployed to support payload characterization. Once the payload characterization has completed, the test and demonstration phase will begin testing spacecraft capabilities to detect and geolocate beacons in several geographical locations. The 3 key objectives of the test period is to demonstrate that the vehicles can 1) detect EPRIBs, 2) geolocate the EBIRB, and 3) pull out the GPS coordinates embedded in the EPIRB signal if the signal can be demodulate and that the GPS information exists. These objectives, the performance parameters in table 5 and any additional metrics identified by Coast Guard-926 will be demonstrated during the test period. There will be a dry run period (also known as a dress rehearsal) and then the final demonstration.

The Aerospace team will lead the Test and Evaluation working group, pulling together all the stakeholders and will be responsible for developing the test strategy. CG-926 will be responsible for developing the test plan and test procedure and identifying any additional performance metrics.

The Test Decision Authority will be the ASAP Program Manager and the Test Director will be the responsibility of CG-926.

The HE360 satellite contact, bus and payload initialization, and payload characterization will be the responsibility of HE360 to conduct as a commercial company (outside the scope of the ASAP contract). However, HE360 will participate during the ASAP Polar Scout payload characterization activities and during the test and demonstration periods.

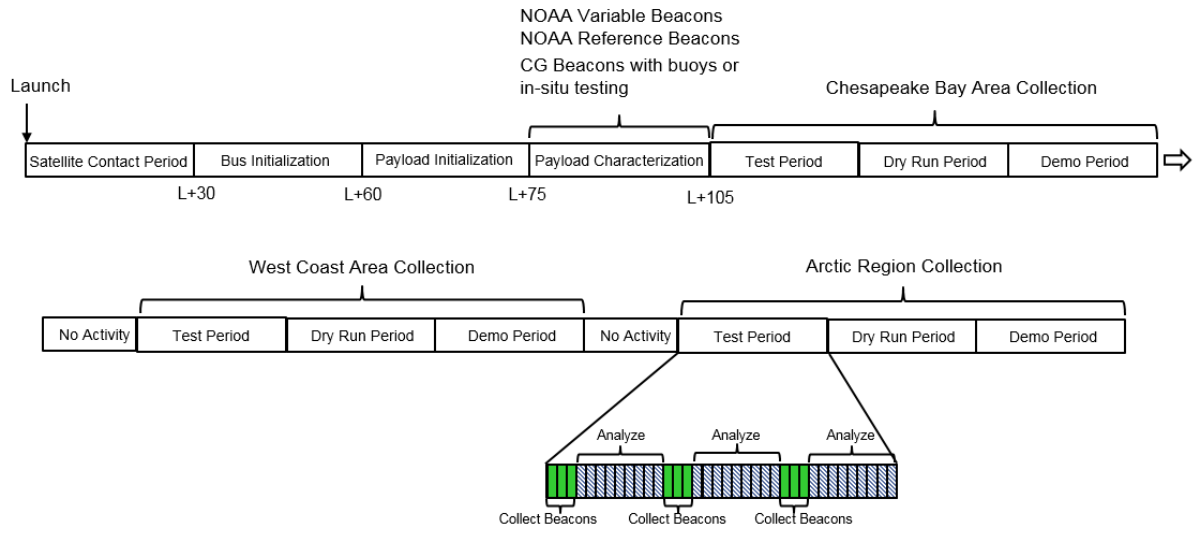

Figure x: Polar Scout Test and Demonstration Strategy

2.1.1.2 Data Analytics

TBD

2.1.1.3 Artic Communications

TBD

2.2 Customer Engagement

The project team is working closely with CG 926 on requirements and test and evaluation plans. This relationship is codified in a MOU and IAA documents.

Bi-weekly meetings are held with DHS, Coast Guard, CubeSat development contractors, CubeSat payload developer, ORS partner, NRO partner, and support contractors to discuss Polar Scout technical and schedule status and issues. One bi-weekly meeting is held with the 6U CubeSat and payload stakeholders and a second bi-weekly meeting is held with the 3U CubeSat and payload stakeholders. These meetings enable all stakeholders to review the status, discuss and resolve any issues, and revalidate scope and objectives.

Beginning April 2017, bi-weekly meetings will be held with all stakeholders, including NOAA and Coast Guard (RDC), to flesh out the test and evaluation phase, including objectives, resources and success metrics. Initial discussion have been ongoing since mid 2016. These T&E meetings will enable Coast Guard and NOAA to ensure the tests conducted support their objectives.

2.3 Customer Requirements

The project staff has and will continue to interact weekly with customers and their technical support group staff, to understand their challenging requirements and to guide program execution. In addition to the primary customer, the program conducts regular interactions with

other potential customers and partners such as HSARPA/BMD, NOAA, DOD/J39, NGA, AF, NRO, and NMIO. These are interagency organizations comprised of DHS, DoD, National Lab, international, state, local, and tribal representatives. ASAP shares information to maximize the utilization of resources and avoid duplication of effort. This interaction also informs the program of the progress of the current acquisition program and end users challenges and needs.

2.4 Key Functions and Desired Performance Requirements

2.4.1 Polar Scout

In the Arctic, the current time-to-geolocate a 406 MHz emergency beacon without GPS is 90 to 180 minutes plus the flight time to execute a rescue. Survival times in Arctic waters, without cold water survival gear, are often less than 60 minutes. The primary demonstration capability that ASAP intends to develop, integrate, and demonstrate will, when fully deployed, reduce the average time-to-geolocate such a beacon to less than 60 minutes. Other capabilities that it will demonstrate, but are secondary objectives, are data communications and ice flow detection. Emergency beacon time-to-locate, Arctic data communications throughput, and ice flow detection accuracy metrics are listed in table 5, below.

Metric Name	Current Capability	Threshold Objective	Project Objective	Current Status
406 MHz Emergency Beacon without GPS Time-to-detection	Average via COSPAS-SARSAT: 46 min	Average extrapolated from project T&E: 30 min ("Average extrapolated" means estimate for a full constellation based on T&E results of project)	Average extrapolated from project T&E: 30 min ("Average extrapolated" means estimate for a full constellation based on T&E results of project)	Waiting on T&E in 2Q and 3Q FY18
406 MHz Emergency Beacon without GPS Time-to-geolocation	Average via COSPAS-SARSAT: 90 min	Average extrapolated from project T&E: 60 min ("Average extrapolated" means estimate for a full constellation based on T&E results of project) Time to provide location as a web service: less than 1 minute from geolocation	Average extrapolated from project T&E: 30 min ("Average extrapolated" means estimate for a full constellation based on T&E results of project)	Waiting on T&E in 2Q and 3Q FY18
406 MHz Emergency Beacon without GPS geolocation accuracy	Average via COSPAS-SARSAT Doppler method: within 5 km	Average via T&E: 10 km (location accuracy less important than time-to-geolocation for maritime Arctic SAR; tasked rescue assets have direction-finding capabilities)	Average via T&E: 5 km (location accuracy less important than time-to-geolocation for maritime Arctic SAR; tasked rescue assets have direction-finding capabilities)	Waiting on T&E in 2Q and 3Q FY18
Channel 16 detection distress detection beyond 20 nmi of coast	N/A from Rescue 21 or COSPAS-SARSAT	Detect, record, and playback channel 16 transmissions	(i) Also automatically identify distress words (e.g., mayday, pan-pan), (ii) Display detection region on CG COP	Waiting on T&E in 2Q and 3Q FY18
Channel 70 detection distress detection beyond 20 nmi of coast	N/A from Rescue 21 or COSPAS-SARSAT	Detect, record, and display channel 70 digital selective calling transmissions	(i) Display detection region on CG COP (ii) Decode DSC message and display any embedded location information on CG COP	Waiting on T&E in 2Q and 3Q FY18

Table 5: Performance Parameters – Polar Scout

2.4.2 Data Analytics

TBD

Table x: Performance Parameters – Data Analytics

2.4.3 Arctic Communications

TBD

Table y: Performance Parameters – Arctic Communications

3. Technology and Innovation

3.1 Core Technology

The major components of the ASAP system are listed below.

- An open architecture, open APIs, and an open data model will be central to the design of the ASAP processing node. The ASAP processing node will maintain a set of interfaces (APIs) that are meant to ensure interoperability between data systems across the various suite of sensors and sensor types. This open architecture will enable the ASAP software to interoperate with other components' existing systems. As mentioned previously, the ASAP open framework will consist of standards for three different levels: Infrastructure Services, Common Services, and Mission Services.
    - IMDE/CSS is a DHS S&T program that will be leveraged by ASAP and will be part of the ASAP open architecture. IMDE/CSS will demonstrate an enterprise-wide system of maritime nodes providing streams of near real-time sensor data and access to non-sensor data including information, analysis, and archives. This system will access, process, and fuse data from mission feeds and diversified sensor sources and make it available through a web-based portal to all system users. IMDE/CSS is built on a scalable and "pluggable" micro-service architecture with robust core services to include logging, identity management, data entitlement, and federated discovery.
    - ASAP plans to integrate onto IMDE in a later phase of the project. Polar Scout is not planned to integrate onto IMDE, however the Data Analytics does plan to integrate onto IMDE. The timeline (initially or at a later phase) of integrating onto IMDE is still under review.

- **3.1.1 Polar Scout**

- Identification and development of space-based sensor feeds, where the focus is the identification and leveraging of existing commercial and government sensors; and procuring new sensors to fill MDA gaps. There are two variants of CubeSats and SmallSats that are under development by HE360 and USAF ORS.
    - **ORS**: DHS S&T has executed an MOU with USAF ORS to collaborate in the demonstration of an on-orbit capability to collect relevant data in support of the DHS mission and the ORS mission to enable rapid low-cost space capability. ORS has developed a flexible, reusable, government-owned design for "6U" CubeSats. ORS employs autonomous manufacturing, modular open system architecture, and open standards. ORS will demonstrate autonomous "open manufacturing" of low volume, high-value assets and autonomous digital techniques to provide mission assurance. DHS plans to leverage a 2-ball ORS constellation to perform RF signal detection in support of the USCG mission.
    - **HE360**: HE360 is a commercial company focused on space-based sensing of radio-frequency (RF) signals and analytic applications of such data sets. The company intends to launch a constellation of satellites (3) able to perform RF signal detection, geolocation, and identification in early 2017. HE360 is under contract with DHS S&T to support on-orbit testing, evaluations, and integration of their systems with Mobile CubeSat Command and Control (MC3) System
    - **MC3 System**: The MC3 System is a network of fully autonomous ground stations. ASAP will purchase two MC3 ground stations and is working with the USCG's Rapid Development Program to determine locations where MC3 will be installed.

MC3 will be integrated into the USCG's Rescue Operations Centers, supporting Arctic MDA including search-and-rescue.

- Through collaboration with ORS, HE360 and MC3, DHS S&T and USCG will demonstrate, test, and evaluate detecting emergency distress beacons from space utilizing multiple on-orbit constellations of CubeSat systems. The space-based sensor data will be incorporated into predictive analytics and fusion tools to improve the arctic MDA mission area.

3.1.2 Analytics

Update this section.

3.1.3 Arctic Communications

TBD

3.2 Technology Scouting

3.2.1 Polar Scout

The technology scouting for this project was conducted by engaging S&T's RDP technology scouting group, conducting discussions with USCG and NOAA, and executing a trade space analysis of alternatives.

In the case of maritime emergencies, the position of the emergency can be sent to satellites, aircraft, and ground-based antennas for those ships mandated to carry Emergency Position-Indicating Radio Beacons (EPIRBs). Below, existing capabilities and limitations for detecting and tracking EPIRBs are discussed.

- USCG SRR only has Rescue 21, which only provides coverage 21 nautical miles (NM) from shore. Additionally, the northern Alaska Rescue 21 towers will not have direction finding capability.
- Not all rescue beacons have embedded Global Positioning System (GPS). What this means is that it will take multiple passes by a satellite to triangulate a position and therefore increasing response time. SARSAT coverage is not persistent and can require multiple passes to trigger an alert. Existing systems can detect distress signals globally.
    - Additionally, challenging search and rescue response times in the Arctic, are the small number of satellites available that have to pass over a beacon to detect and locate it, before they can send the signal to ground stations.
    - The next-generation SARSAT ("MEOSAR") continues to be delayed (part of GPS Block III) with full deployment 5-10 years away.

3.2.2 Analytics

- Lack of access to space-based resources and data products
    - Access to National Technical Means (NTM) data
    - DHS priorities compete against national intelligence priorities
    - Timeliness of NTM data does not meet DHS needs
    - Difficult to receive unclassified data from NTM systems

- Need for unclassified SAR information
    - To share with international, state, local, and tribal representatives.
    - Where data is admissible in court
    - Publicly releasable for safety of navigation

3.2.3 Arctic Communications

TBD

3.3 Technical Approach

3.3.1 Polar Scout Trade Space Analysis

Four broad range of solutions were considered in the ASAP trade space analysis: terrestrial, maritime, airborne, and space-based. To assess the alternatives, the trade study examined a 200 by 200 NMI area 100 NM north of Barrow, Alaska, and the entire Juneau Alaska region. Each option was assessed by its ability to provide continuous coverage (24 hours per day, seven days per week) and provide a minimum of a 30 minute revisit time.

Each alternative was assessed in the following areas:

- Platform acquisition cost
- Access to area of interest
- Technical maturity/feasibility

3.3.1.1 Preferred Alternative

Within each solution category (terrestrial, maritime, airborne, and space-based) many potential configurations were constructed and assessed. The space-based solutions using CubeSats proved to be the optimal solution in the ability to provide a 30-minute revisit and were the least expensive alternatives. The best land-based, airborne, and maritime solutions were cost-prohibitive or had insufficient range when compared to the CubeSat space-based solution.

3.3.1.2 Logistics Considerations

Logistics were not taken into consideration in the trade space analysis since other factors disqualified the non-CubeSat alternatives due to their high cost of acquiring the asset, access to coverage area, and technical maturity.

3.3.1.3 Polar Scout Technical Approach

3.3.1.3.1 Design, Development, and Integration Approach

Polar Scout is leveraging design and development activities performed under other government or commercial contracts.

The 6U CubeSats have been under development for approximately 5 years by ORS. When DHS decided to leverage the ORS 6U CubeSats, the CubeSats had already passed their CDR milestone approximately two years prior. The milestones

monitored by DHS will be bus and payload integration activities, bus and payload test activities (e.g. thermal, environmental, etc) and ground processing activities. DHS is leveraging a payload design (by Rincon) that is currently in operations on another CubeSat. This payload will be integrated into the 6U CubeSats. The milestones monitored by DHS will be payload fabrication, payload and bus integration, payload test activities (e.g. thermal, environmental, etc), and payload processing activities. The ASAP Program Manager has decision authority of all 6U flight build, payload integration and test activities, and deviations that are directly related to the operations of the 6U CubeSats.

Polar Scout is leveraging the HE360 commercial development effort to acquire additional EPIRB data. For the HE360 contract, the ASAP Program Manager has decision authority for only those design, development, and test activities related to the collection and processing of EPRIB data.

A portion of the Analytics contract (RadiantBlue/HumanGeo) will be for RadiantBlue/HumanGeo to perform as the ground integrator for Polar Scout. RadiantBlue/HumanGeo will integrate the EPIRB data from both HE360 and the 6U and provide that data to the USCG and NOAA as agreed upon. To reduce cost and to further separate the Polar Scout and Analytics efforts, the ASAP project is also investigating the possibility of having Rincon integrate the EPRIB data from both the 6Us and HE360.

3.3.1.3.2 Communication Approach

The ASAP Program Manager has stood up several IPTs to monitor the Polar Scout activities. Stakeholders for the 6U CubeSat effort meet weekly in the Technical IPT and the Ground IPT. Through these two IPTs, the Polar Scout Program Manager gains insight into the status, issues, risks, and resolution of challenges. The ASAP Program Manager also has a bi-weekly technical and budget meeting with the 6U prime contractor. In addition the ASAP Program Manager conducts a status meeting with Aerospace to review project status, actions, risks, and open items.

For the HE360 contract, HE360 provides monthly status and budget reports. TEMs are held approximately monthly to review the status, issues, risks, and resolution of challenges.

3.3.2 Analytics

For the RadiantBlue/HumanGeo contract, the Program Manager meets with the team bi-weekly to review the status, issues, risks, and resolution of challenges. These meeting just began during the month of March 2017.

3.3.3 Arctic Communications

TBD

4. Project Management

4.1 Acquisition Management

4.1.1 Program Acquisitions

Acquisition Description	Acquisition Strategy (Contract, BAA, Grant, IA etc.)	Location of Work To Be Performed	Period of Performance	Award FY/Q	Total Estimated Value
CGSARSAT Payload Integration and Test	IAA	Contractor facility	24 months		520
Space RF Detection & Location	IAA	Contractor facility	12 months		750
HawkEye 360	IAA	Contractor facility	24 months		997
IGCE Ames	IAA	Contractor facility	17 months		4,944
CGSATEVAL	IAA	Contractor facility	18 months		355
Aerospace Corporation	IAA	Contractor facility & DHS S&T	12 months		1,500
RAND for CONOPs and Business Case Study	IAA	Contractor facility	11 months		222
SRI (for IMDE Support)	TBD	TBD	TBD		TBD
HSSEDI (for IMDE in DAE)	TBD	TBD	TBD		TBD
Arctic Data Hub	IAA	Contractor facility	24 months		640
NASA JPL Team	IAA	Contractor facility	7 months		100
TOTAL					10,967

4.1.2 Acquisition Strategy

The primary performers for each acquisition description in table 4.1.1 are known performers previously or currently engaged by the USG partner organizations listed 1.5. Thus, ASAP is leveraging multiple existing contract vehicles by the United States Air Force, the Unites States Navy, and NASA. ASAP is accessing these contract vehicles via Interagency Agreements.

4.1.3 Potential Sources

The following tables identifies the data sources for Polar Scout

Table x

The following table identifies the data sources for Analytics

Table x

The following table identifies the data sources for Arctic Communications

Table x - TBD

4.2 Scope Management

4.2.1 Work Breakdown Structure

The following table contains the project work breakdown structure.

NOTE: Update the below table below to create 3 WBS categories to capture Polar Scout, Analytics, and Arctic Communications. This table should mirror the high level schedule.

Element	Title	Description
2.0	ORS System	Develop, build, and launch two 6U CubeSats for use in support of DHS Components. DHS plans to leverage a 2-ball ORS constellation to perform RF signal detection in support of the USCG mission.
3.0	HE360 System	HE360 is under contract with DHS S&T to support on-orbit testing, evaluations, and integration of their systems with Mobile CubeSat Command and Control (MC3) System. DHS plans to leverage HE360 systems to perform RF signal detection in support of the USCG mission.
4.0	Mission Integration	Lead and facilitate space/ground integration testing, ASAP CubeSat IPTs, and maintain contractor giver/receivers lists.
5.0	ASAP Ground Development	ASAP ground will create a multi-source analytics, which focuses on sensor exploitation enhancement of tracking, tipping, and queuing of objects relevant to the USCG mission.
5.1	ASAP Ground	ASAP will develop an analytics chain that includes commercial and government small satellite data feeds

		and processing tools that will be utilized during the T&E, with an operational focus for SAR mission.
5.2	Project End-to-End I&T	Support integration of data processing and data feeds onto platform, integration of mission planning onto IMDE/CSS, and integration and test of government and commercial data feeds/products onto framework (IMDE/CSS).
5.3	Test and Evaluation	Develop Test Scenarios, support software test and integration activities, and support End-to-end testing activities.
6.0	Coast Guard	S&T is developing and testing this technology with the participation of components acquisition and operational leads.
6.1	Polar Scout	USCG team will development metrics and lead T&E for the ASAP SAR demonstration.
6.2	Component Pilot	Support transition of ASAP to Component.
7.0	Analytics	Insert information here
8.0	Arctic Communications	TBD

Table 6: Work Breakdown Structure

4.2.2 Scope Control Plan

The requirements baseline cannot be changed without approval from the Project Manager and the customer.

4.3 Schedule Management

4.3.1 Polar Scout Milestones/Deliverables

Figure 2 depicts the overall project schedule.

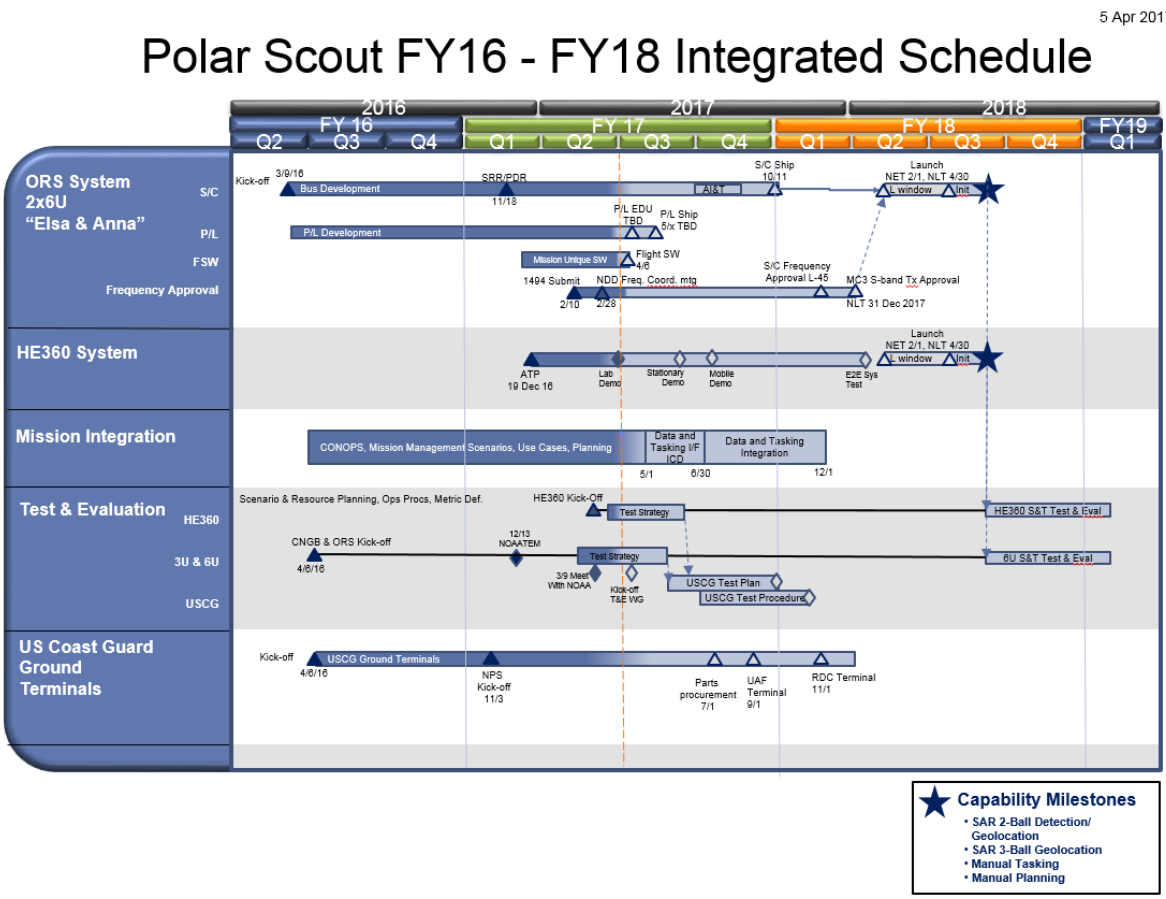

Figure 2: ASAP FY16-FY18 Schedule

Table 7 lists the major milestones. The two major CubeSat (ORS/6U, & HE360) demonstrations are listed in the Test and Evaluation section. Transition to USCG and NOAA milestones are listed in the Operations section.

Major Project Milestones/Deliverables by Phase	Scheduled Date
ORS/6U System	
SRR/PDR	Nov 2016
Payload Deliverable	3QFY17
Flight Software	3QFY17
Payload & Bus I&T	4QFY17
Ground Build (SOC/MOC)	4QFY17
Frequency Approval	L-60 days
Launch	2/1/18
HE360 System	
Lab SOI Demo	3/31/17
Stationary Emitter Airborne Demo	6/6/17
Mobile Emitter Airborne Demo	7/18/17
End-to-End Demo	Feb 2018

Major Project Milestones/Deliverables by Phase	Scheduled Date
Launch	2/1/18
Polar Scout Ground Integration	
EPIRB Data Interface ICD	3QFY17
EPIRB Data Integration	1QFY18
Tasking Interface ICD	3QFY17
Tasking Integration	1QFY18
Test & Evaluation (Demonstrations)	
Test Strategy	4QFY17
USCG Test Plan	4QFY17
USCG Test Procedure	4QFY17
HE360 T&E Complete	L+6 months
6U T&E Complete	L+6 months
USCG Ground Terminals	
Parts Procurement	4QFY17
Terminal (UAF)	4QFY17
Terminal (RDC)	1QFY18

Table 7: Polar Scout Milestones and Deliverables by Phase

4.3.2 Analytics Milestones and Deliverables

TBD

4.3.3 Arctic Communications Milestones and Deliverables

TBD

4.3.4 Schedule Control Plan

The schedule is managed continually. Schedule updates are provided by performers and the system integration function, and monitors planned versus actual performance to gauge schedule adherence.

4.4 Cost Management

4.4.1 Cost Estimate

The cost estimate for FY16 and FY17 are closer to actual dollars obligated. FY18 is an estimate based on cost knowledge from previous technology development experienced and discussions with USCG and other components where ASAP could be transitioned.

Funding Source	FY16	FY17	FY18	Total
Internal (S&T)	$12M	$2M	$5.3M	$19.3M

Table 8: Cost Estimate

4.4.2 Cost Baseline

Project Activities	FY16 Obligated	FY17 Obligated	FY18 Budgeted
Mission Integration	$1,000,000		
CNGB System	$1,270,000		
ORS System	$5,000,000		
HE360 (Commercial Satellite)	$1,000,000		
ASAP Ground/Data Analytics	$1,750,000	$2,100,000 (planned)	
Operations Test & Evaluation	$555,000		
Overhead/Tax	$300,000		
Total	$10,875,000	$2,100,000	TBD

Table 9: Cost Baseline

4.4.3 Cost Control Plan

Cost monitoring will be based on the agreement each servicing agency has established in the contracting vehicle used. These are specified in the individual contract vehicles. ASAP will work with the individual contracting officers to manage costs. ASAP will examine schedule progress as part of the cost review to maintain a comprehensive picture of the project. Monthly variances greater than those established in the individual IAAs will be examined to determine a) root cause of the variance, b) any impacts to project deliverable dates/quality, and c) corrective actions to bring the project closer to plan.

4.5 Status Reporting

Periodic (monthly or bi-weekly) status reports are collected from all performers. These reports summarize successes, problems encountered, project measures, such as cost, schedule and performance variances, as well as any additional relevant measures. Daily communication will take place between the Aerospace team and the Program Manager to discuss other details concerning the program.

4.6 Cost/Schedule/Performance Trade-Offs

Not applicable

5. Risk Management

5.1 Risk Management Plan

The Risk Management approach includes the maintenance of all program risks in a program risk register. This risk register is reviewed at the weekly ASAP Status Meetings. The ASAP Program Manager serves as the Risk Manager and Aerospace, as the ASAP Program Systems Engineer, facilitates the Risk Management process by maintaining the risk register and hosting it on the Aerospace ASAP Program sharepoint site (https://aerospacecloud.sharepoint.com/sites/Ext-DHSOCS-STProjects/Limited%20Access%20Docs/Forms/AllItems.aspx). In order to mitigate risks on the program, each activity holds regular meetings, identifies risks and includes then in the ASAP Risk Register action trackers. Each activity, maintains an action tracker and these risks are all included on the overall ASAP Risk Register.

The program uses a classic 5X5 matrix to rate the likelihood and consequence of each risk. This evaluation methodology is shown in figure 1.

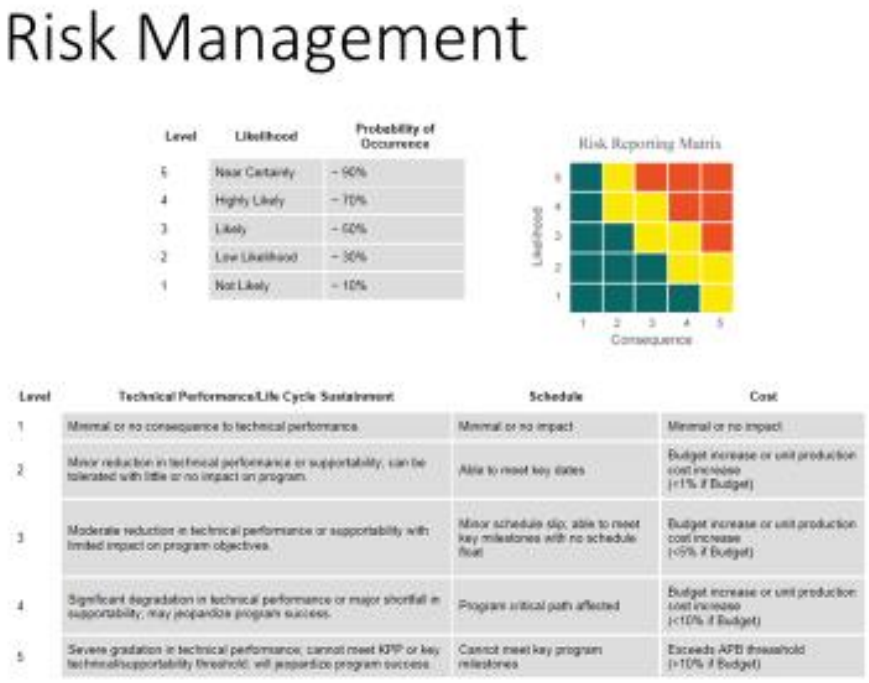

Figure 1: ASAP Risk Management Methodology

Once a risk is identified, the risk register maintains the following four pieces of information regarding the risk:

- Risk – Description of the risk
- Mitigation – Planned mitigation
- Impact – Estimated impact should risk be realized
- Status – Open, closed, or any change since last review

5.2 Risk Identification and Assessment

The risks associated with this project are as follows: Technical, and Programmatic.

5.2.1 Technical Risks

The technical risks are updated monthly and maintained in the project risk register.

5.2.2 Programmatic Risks

5.2.2.1 Cost Risks

The cost risks are updated monthly and maintained in the project risk register. ASAP has a success-oriented cost profile so cost must be reviewed frequently.

5.2.2.2 Scope/Performance Risks

The scope and performance risks are updated monthly and maintained in the project risk register. There are currently no identified scope/performance risks on this project.

5.2.2.3 Schedule Risks

The schedule risks are updated monthly and maintained in the project risk register. ASAP schedule risk drive technical risks. Schedule and schedule interdependencies are closely tracked as sources of risk.

5.2.3 Operational Risks

Not applicable

5.3 Risk Register

See section 5.1.

6. Appendix A – Acronyms

Acronym	Definition
AIS	Automatic Identification System
API	Application Program Interface
ASAP	Advanced Sensor Analytics Project
BMD	Borders and Maritime Security Division
CBP	Customs and Border Patrol
CSS	Coastal Surveillance System
DA-E	Data Analytics Engine
DHS	Department of Homeland Security
DoD	Department of Defense
EPIRB	Emergency Position-Indicating Radio Beacons
FY	Fiscal Year
GPS	Global Positioning System
HE360	HawkEye 360, Inc
HSARPA	Homeland Security Advanced Research Projects Agency
I&A	Intelligence and Analysis
IAA	Interagency Agreement
IC	Intelligence Community
IMDE/CSS	Integrated Maritime Domain Enterprise/Coastal Surveillance System
IPT	Integrated Product Team
MC3	Mobile CubeSat Command and Control
MDA	Maritime Domain Awareness
MEOSAR	Medium Earth Orbit Search and Rescue
MID	Mission Integration Directorate
MOU	Memorandum of Understanding
NM	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration
NPS	Naval Post Graduate School
NRE	Non-Recurring Engineering
NRO	National Reconnaissance Office
NTM	National Technical Means
OA&M	Operations, Administration, and Management
ORS	Operationally Responsive Space
PEO	Program Executive Office
RDC	Research and Development Center
RDT&E	Research, Design, Test, and Evaluation
RF	Radiofrequency
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite Aided Tracking System
SRR	Search and Rescue Response Regions
S&T	Science and Technology
STPS	S&T Project Site

T&E	Test and Evaluation
TRL	Technology Readiness Level
US	United States
USCG	United States Coast Guard
USG	United States Government

Table A1: Acronyms