Systems Engineering Analysis Cohort 24 (SEA-24)

"High Altitude ASW for the P-8A"

IPR #1

12 Sep 2016

LT Shawn Buchan, USN
LT Chris Horel, USN
LT Dave LaShomb, USN

SEA-24 Cohort Members

SEA-24 Members:

LT Shawn Buchan, USN
Surface Warfare Officer

LT Chris Horel, USN
Surface Warfare Officer

LT Dave LaShomb, USN
Surface Warfare Officer

Faculty Advisor:

CDR Matt Boensel, USN (Ret)
Naval Aviator (P-3C)

SEA Chairman:

CAPT Jeff Kline, USN (Ret)
Surface Warfare Officer

CAPSTONE Timeline

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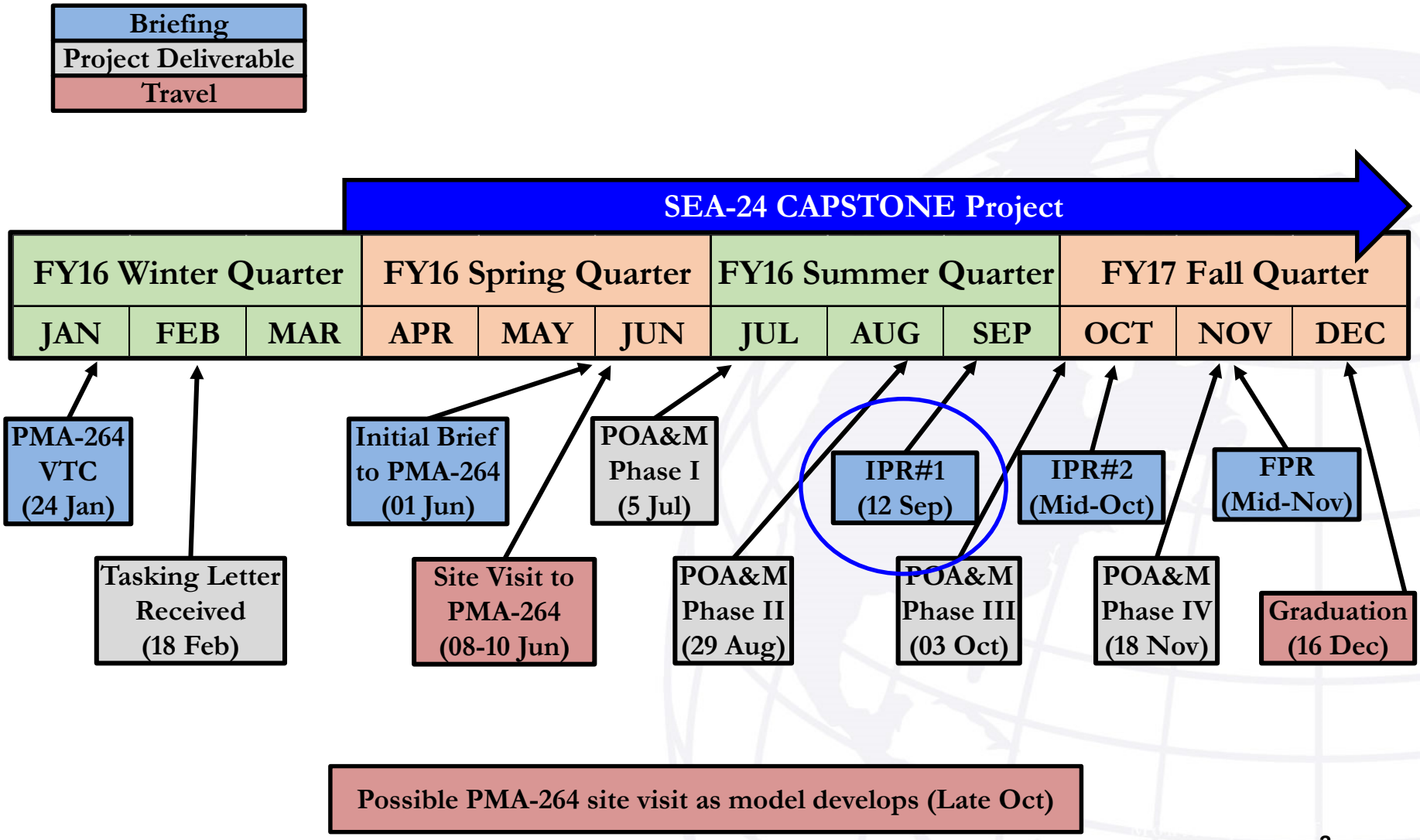

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Project Tasking

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(U) Tasking:

(U) Design a fleet system of systems and concept of operations for employment of a **cost effective and resilient unmanned and manned system capable providing extended sensor search and detection capability for the P-8A** in the 2025-2030 timeframe. Consider manned and unmanned systems to provide sufficient information **to support effective antisubmarine and anti-surface operations to Find, Fix, Track, Target and Engage sequence**. With each alternative, develop a concept of operations, while considering employment requirements, operating areas, bandwidth and connectivity, interoperability, sensor data processing, transfer and accessibility and logistics. Generate system requirements for platforms, sensors, and communications in a challenging EM environment. Develop alternative architectures for platforms, sensors, manning, command and control, intelligence collection/dissemination and consumption, communication and network connectivity, and operational procedures. Address the costs and effectiveness of your alternatives in an area anti-submarine and anti-surface mission areas.

Problem Statement

(U) Problem Statement:

(U) SEA-24 will investigate cost-effective and resilient systems of systems (SoS) to extend sensor search and detection capability for the P-8A in the 2025-2030 timeframe using manned and unmanned systems to provide sufficient information supporting effective high altitude antisubmarine warfare (HAASW) operations in the find, fix, track, target, and engage (F2T2E) sequence.

Tasking Scoped Further

(U) Scoped Tasking:

(U) SEA-24 will investigate a systems of systems (SoS) centered around the P-8A Poseidon and the Coyote® Unmanned Targeting Air System (UTAS) with MAD sensor in an attempt to reduce the time to Find, Fix, Track, Target, and Engage (F2T2E) a submarine while carefully considering cost, operator task saturation, P-8A storage capacity, and projected technological advancements in the 2025-2030 timeframe to ensure each system architecture is a viable system in support of High Altitude ASW (HAASW) operations.

Systems Engineering 'V'

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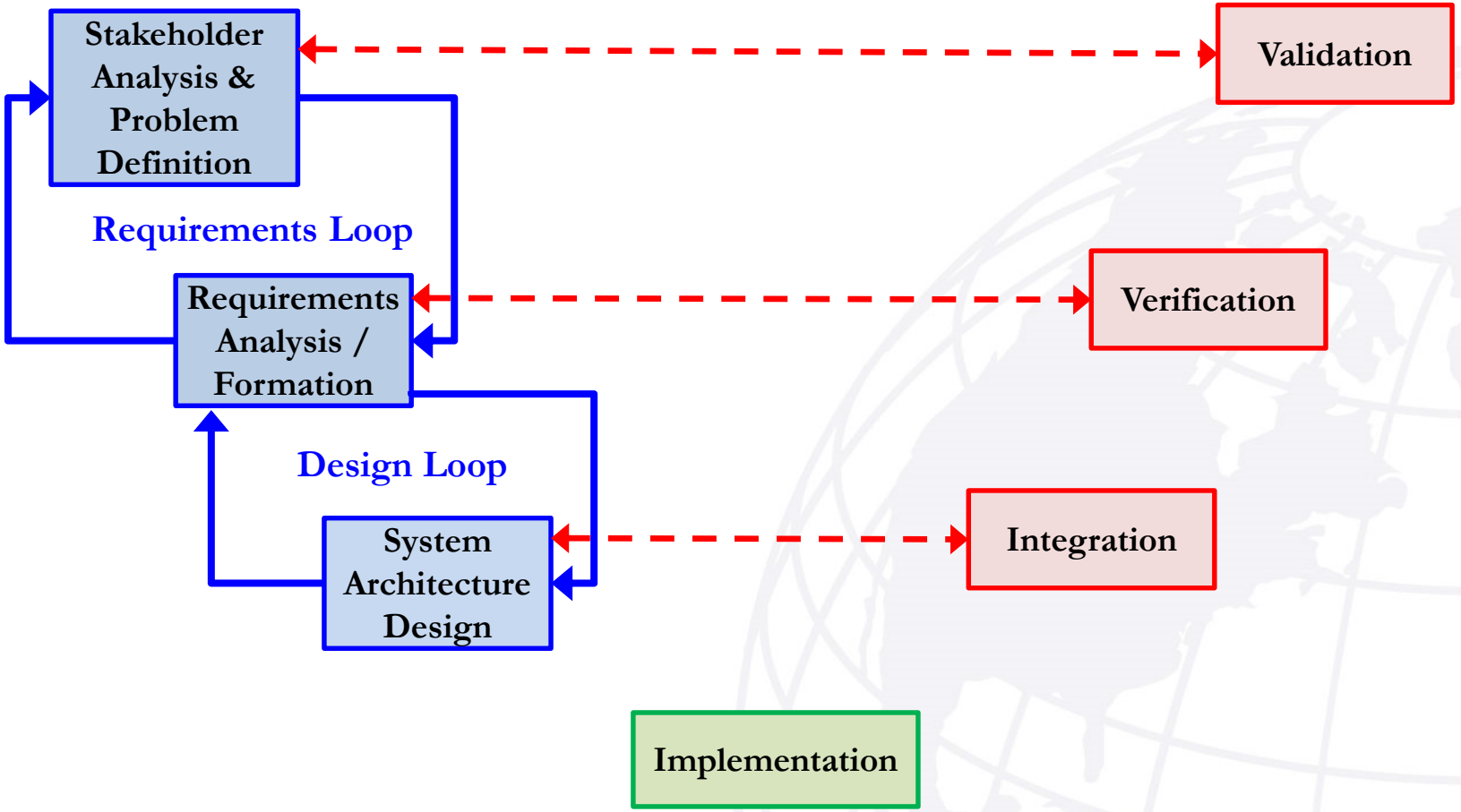

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Systems Engineering 'V'

Stakeholder Analysis & Problem Definition

- Stakeholder Analysis
- Scoping of Project
- Defining the Problem

Requirements Analysis / Formation

- Requirements Definition
- Functional Decomposition
- FFBD
- Assumptions/Constraints

- COI/MOE/MOP
- Architecture Formation
- Alternative Analysis

System Architecture Design

Implementation

- Scenario / Vignettes
- CONOPs

Integration

- Operational Limitations
- Physical Constraints

Verification

- Modeling
- Simulation
- MOE/MOP Verification

Validation

- Stakeholder Approval
- Future Research/Analysis

Initial Steps

(U) Phase I: Knowledge Collection/Initial Analysis

- Research/Data Collection
- Stakeholder Analysis
- Identify KPP/Primitive Needs
- Initial Problem Statement
- Conceptualize Initial System Design

Completion: 5 July 2016

Initial Steps

(U) Phase II: Establish Requirements/Scenario

- Perform Functional Analysis/Propose MOE & MOP
- Develop System-Level Requirements
- Define Operational Scenario/Concept
- Model Operational Scenario
- Explore Technical/Operational Trade-offs

(U) Completion: 29 August 2016

Focus Areas

(U) Primary Mission Area

- Anti-Submarine Warfare

(U) System of Systems (SoS) Network Architecture

- P-8A Poseidon and Coyote® UTAS with MAD sensor

(U) System Performance

- P-8A Capability
- Coyote® UTAS Capability/Employment
  - SWAP-C limitations
- AN/SSQ-125: Multi-Static Active Coherent (MAC) sonobouy
  - Size of Area of Uncertainty

(U) Initial Concept (CONOPS)

- Find, Fix, Track, Target, Engage (F2T2E) in HAASW
  - How can the time be reduced?

Stakeholders

- **Primary:**
  - NAVAIR ASW Systems (PMA-264)
  - OPNAV Warfare Integration (N9I)

- **Secondary:**
  - Commander, Naval Air Forces (CNAF)
  - Naval Postgraduate School (NPS)

Scenario

Scenario Description (SIPR)

Critical Assumptions

- **(U) UTAS is a Raytheon Coyote®**
  - Expendable UAS from A-size sonobouy pod
- **(U) Type of sound propagation ignored**
  - Treated as "event" within simulation model
- **(U) Probability of False Alarm (P_f) assumed for MAC/MAD**
- **(U) Battery power/life assumed**
  - Projected estimate to the 2025-2030 timeframe
- **(U) AN/SSQ-125 (MAC) "Field" pattern & distances set as constant**
  - Initial MAC Area of Uncertainty (AOU) set as constant (**XX** meters)

What does this mean?

(U) SEA-24 must develop a System of Systems design where system architecture becomes the focus of the analysis.

- (U) How can we employ a UTAS with MAD sensor to sufficiently support the P-8A during High Altitude ASW (HAASW) operations?
- (U) How can we reduce the time required to Find, Fix, Track, Target, and Engage a submarine with a P-8A?
- (U) What becomes the more important UTAS performance trait for each SoS architecture design?
  - UTAS speed vs. UTAS endurance

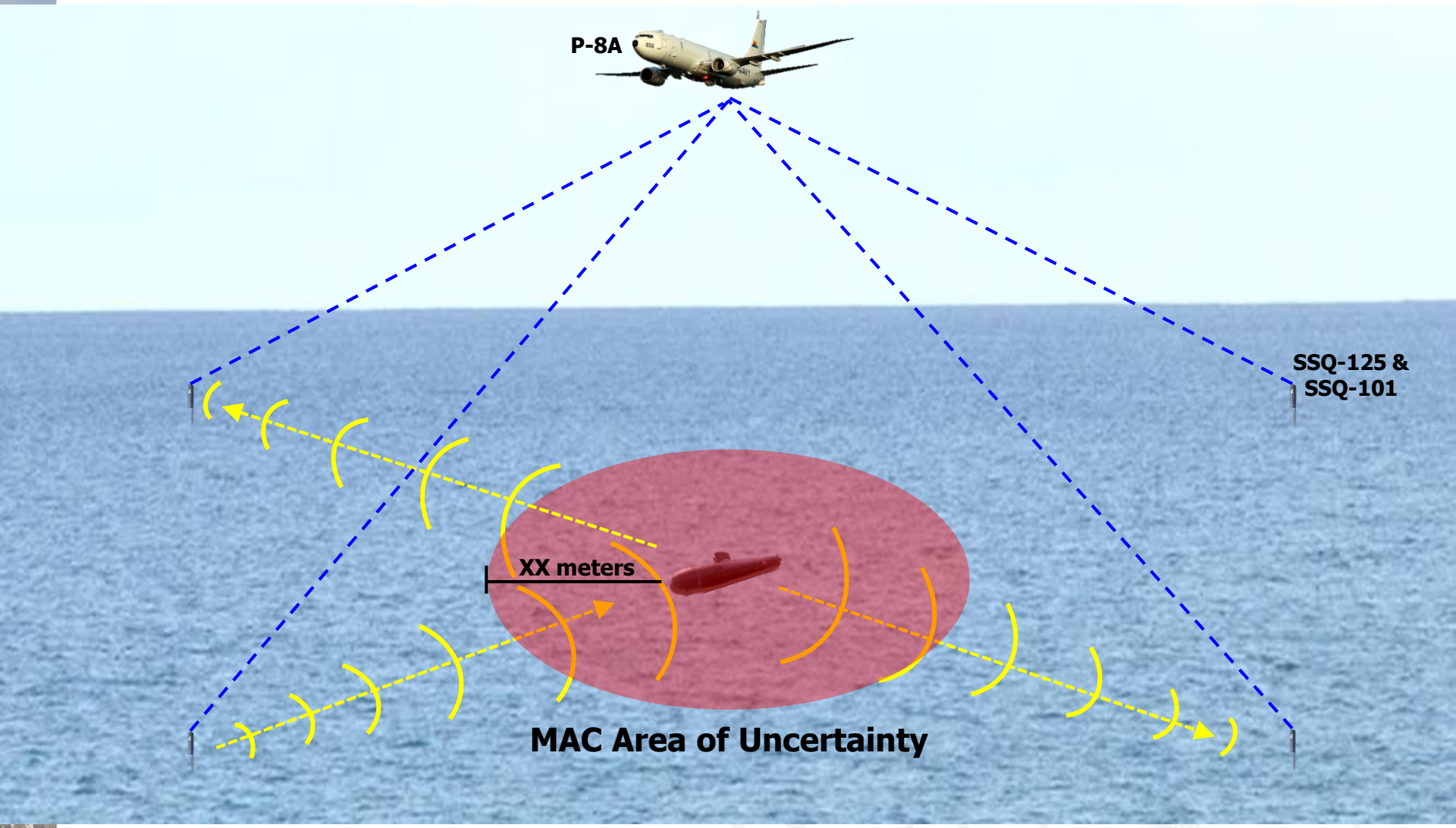
(U) Is a SoS employing UTAS with MAD better than the current doctrine of using DIFAR/DICASS sonobuoys in the Find, Fix, Track, Target, and Engage sequence in terms of time, mission cost, and added functionality to the P-8A ASW mission?

Initial Operational Concept

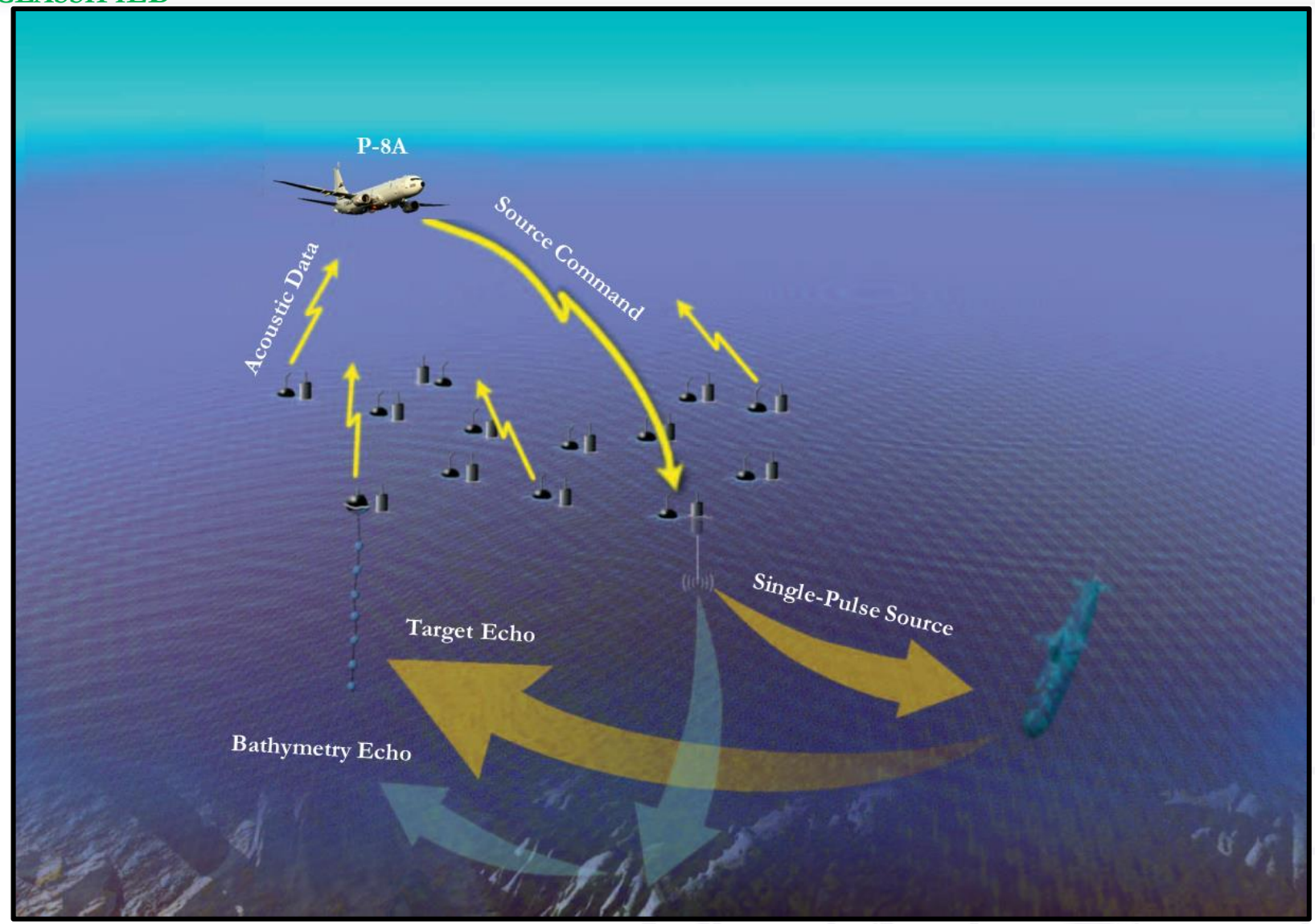
(U) "The Magnetic Anomaly Detection (MAD) for Unmanned Targeting Air System (UTAS) project will develop and deliver a remotely piloted small or midsize UTAS capable of being launched from the P-8A. UTAS will have a digital magnetometer sensitive enough to detect a threat submarine at a specified slant range." – PMA-264

Initial CONOPs (SIPR)

MAC Area of Uncertainty



EER Sonobuoy Field Echo



Coon, Andrew C., et al.
The Extended Echo Ranging Aural and Visual Support Trainer.
John Hopkins Technical Digest, Vol 18, No. 1 (1997)

Operational Concept

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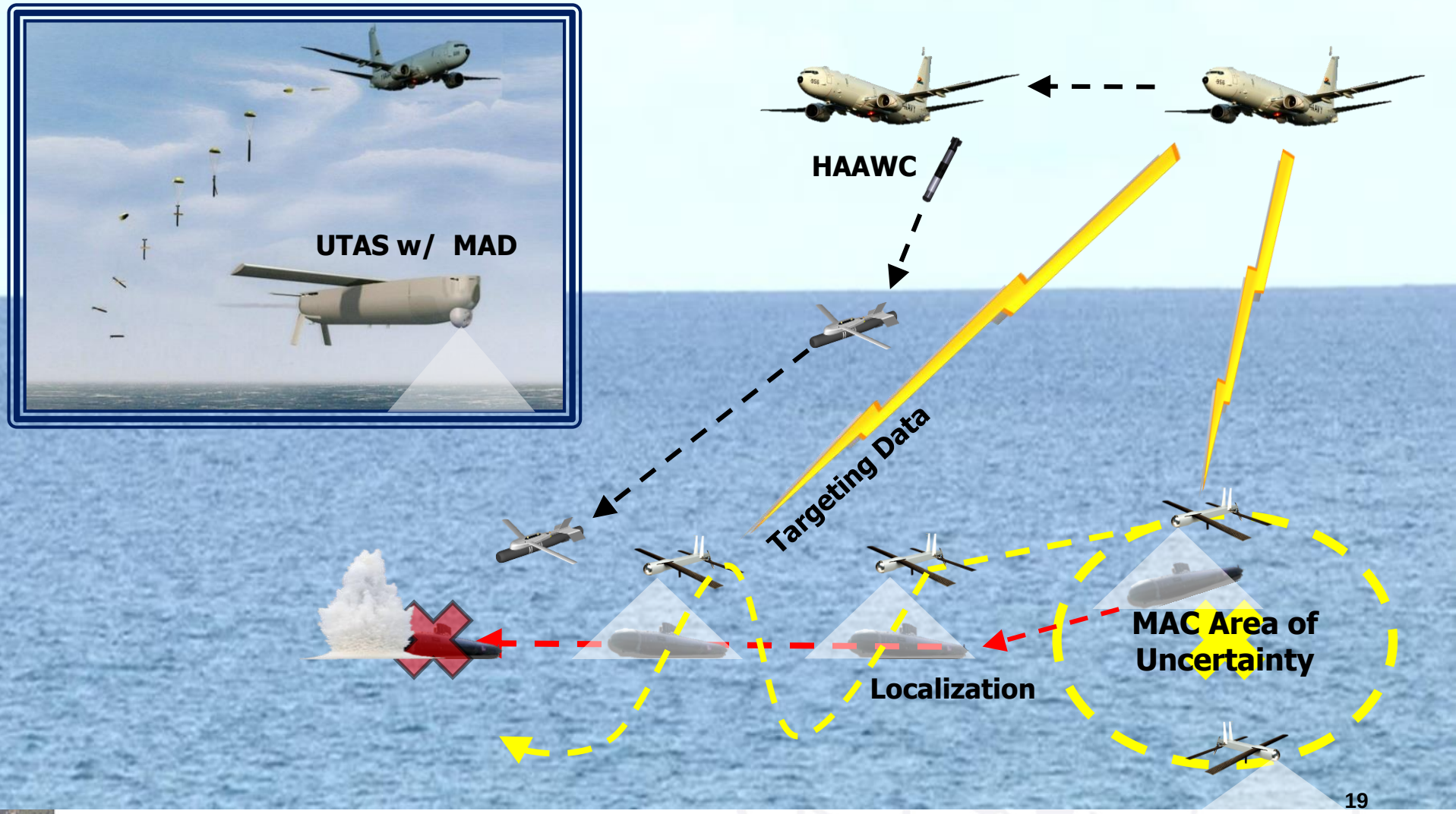
High Altitude ASW w/ P-8A



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Constraints

(U) "UTAS provides an efficient solution to targeting, allowing the P-8A to remain at optimal cruising altitude; thereby increasing time on station, reducing fuel consumption, and reducing maneuver stresses on the airframe that could have a positive effect on air vehicle service life." – PMA-264

- Range restrictions of data links
- UTAS SWaP-C limitations
- P-8A sonobuoy pod storage capacity
- Operator task saturation
- Overall mission cost
- MAC Area of Uncertainty (AOU) size

Projected Model

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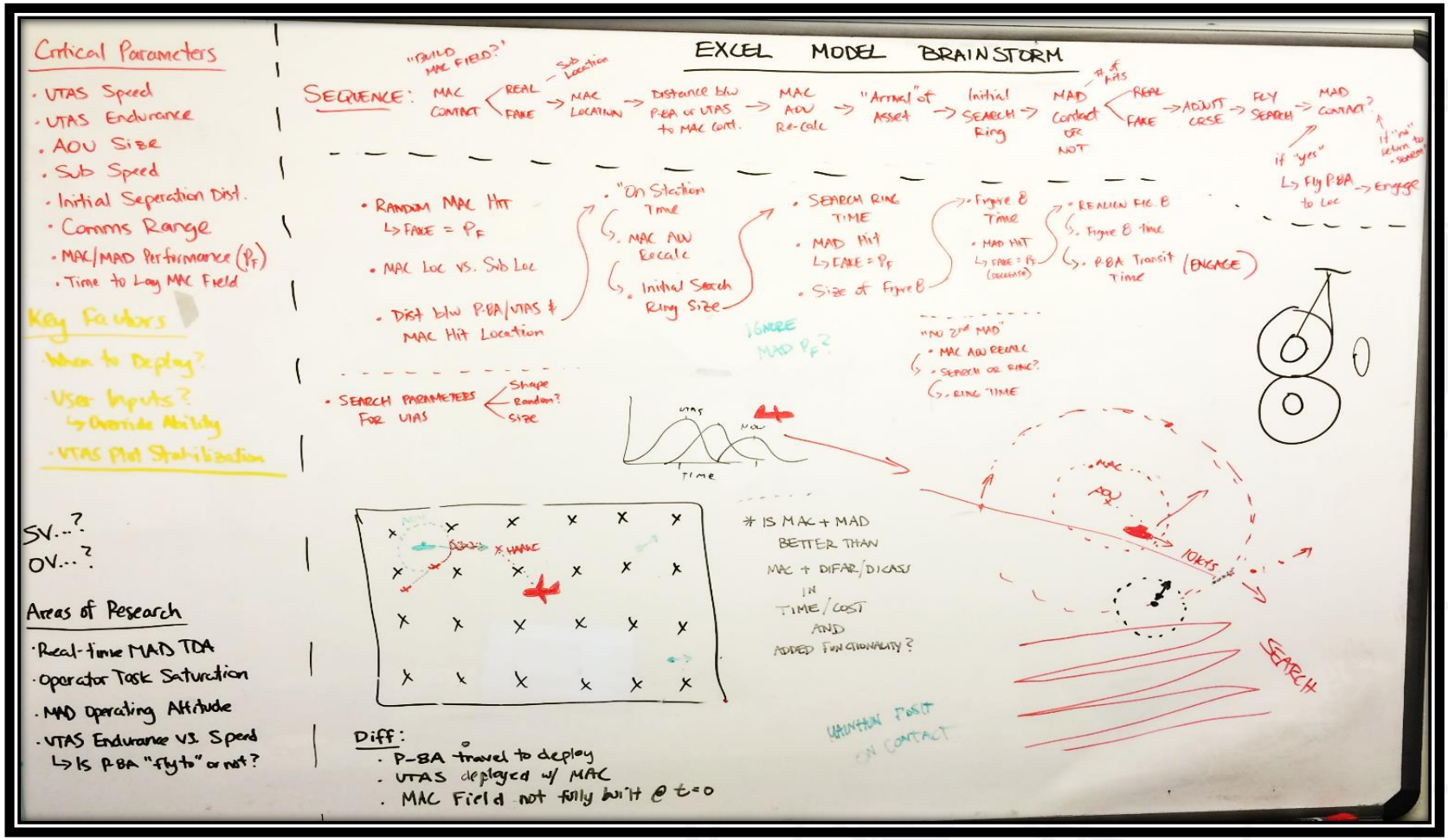


Time-based model analyzing F2T2E sequence across multiple architectures using a Design of Experiments of critical input factors

Requirements

(U) Project Tasking Requirements:

(U) The System of Systems (SoS) shall:

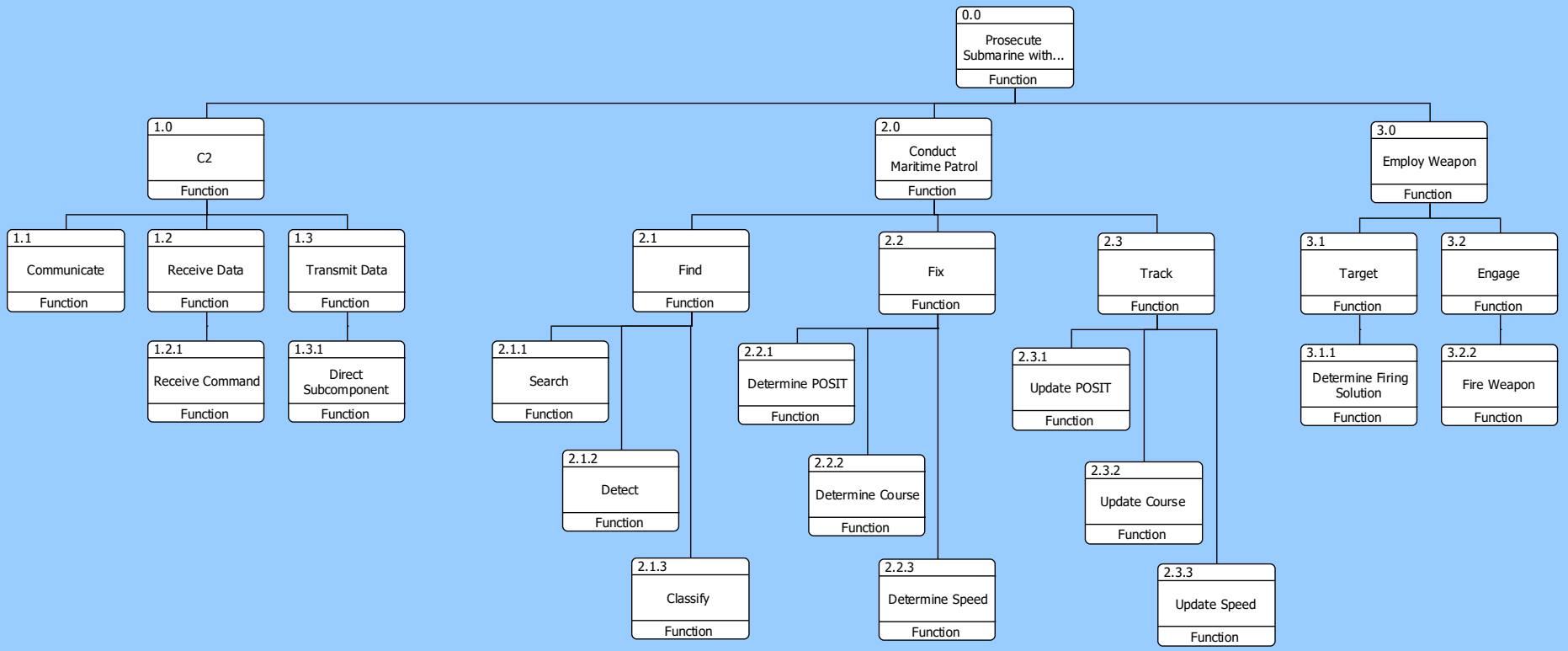
1. Provide extended search and detection capability for the P-8A
2. Provide sufficient information to support effective ASW operations
3. Operate in a challenging electromagnetic (EM) environment

(U) Scoped Requirements:

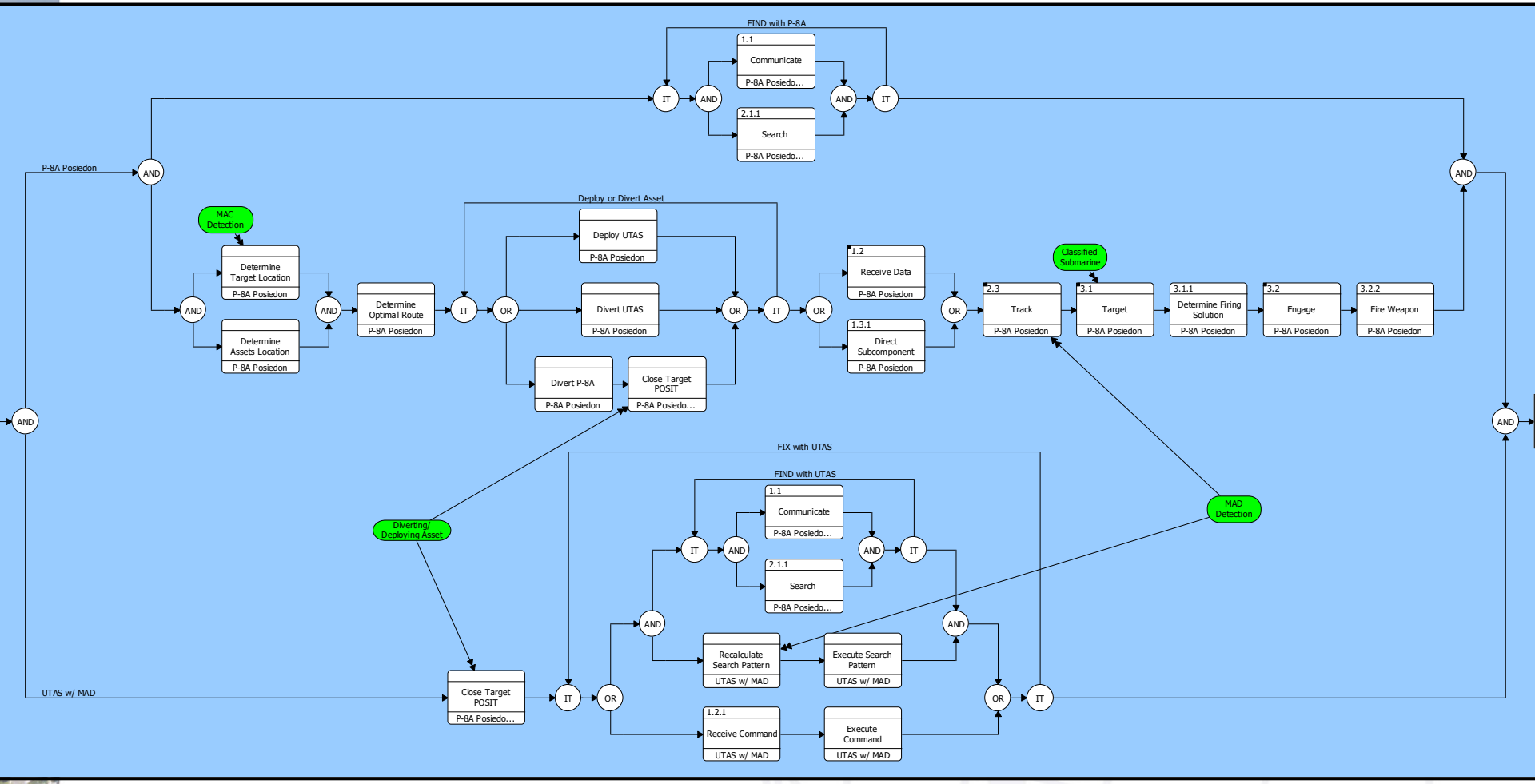
(U) The System of Systems (SoS) shall:

1. Employ an Unmanned Targeting Air System (UTAS) from P-8A with Magnetic Anomaly Detection (MAD) sensor
2. Minimize time required to Find, Fix, Track, Target, & Engage a submarine.

Functional Decomposition



Flow Block Diagram



Critical Operational Issues

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COI	Issue	Question
1	Endurance	Are the achievable SWaP endurance rates of a UTAS platform sufficient to support effective P-8A ASW operations?
2	Transportability	Can the UTAS platform be stored and launched from a P-8A platform to support effective ASW operations?
3	Compatibility	Is the UTAS platform compatible with P-8A ASW mission and communication systems?
4	Command and Control (C2)	Can UTAS provide sufficient information to support effective P-8A ASW operations?
5	Speed	Can the UTAS platform operate at sufficient speeds to support effective P-8A ASW operations?
6	Automation	Can the UTAS platform operate autonomously in support of effective P-8A ASW operations?
7	Employment	Can the UTAS platform be readily employed from the P-8A platform to support effective ASW operations?
8	Survivability	Can the UTAS platform survive a challenging electromagnetic (EM) and physical environment?
9	Reliability	Does UTAS platform reliablity align with the required reliability for P-8A ASW operations?
10	Availability	Does UTAS platform availability align with the required availability for P-8A ASW operations?

Way Ahead

(U) Phase III: Development of Alternative Solutions

- Finalize Measures of Effectiveness (MOE)
- Generate System Design Alternatives
- Conduct Analysis of Design Alternatives (AoA)
- Cost Analysis of Alternatives

(U) Completion: 15 October 2016

Way Ahead

(U) Phase IV: Completion of Report/Analysis

- Validate Capability w/ Gap Analysis
- Build Decision Matrix of Alternatives
- Discuss POM Implications
- Complete Final Report

(U) Completion: 18 November 2016

Remaining Briefs

Initial Project Brief	(U) 03 June 2016
IPR #1	(U) In Progress
IPR #2	(U) Mid-October
FPR	(U) Mid-November

Questions?


SEA-24
NPS
PRAESTANTIA PER SCIENTIAM
1909
DEPARTMENT OF THE NAVY
UNITED STATES OF AMERICA
NAVAL AIR SYSTEMS COMMAND
AIR ASW SYSTEMS
PMA-264
High Altitude ASW for P-8A

Back Up Slides

MAC & SSQ-101 Overview (SIPR)

High Altitude ASW

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HAASW Overview (SIPR)