Test & Evaluation/Science & Technology Program

2012 Underwater Acoustics for T&E Workshop

Penn State University

26 April 2012

Advanced Instrumentation Systems Technology (AIST)
Executing Agent
George Shoemaker, Ph.D.
401-832-5304
george.shoemaker@navy.mil

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Outline

- T&E/S&T Program
  - BAA Process
- Advanced Instrumentation Systems Technology (AIST)
  - Overview & Mission
  - Advanced Sensors Topics
  - Advanced TSPI Challenges
- Unmanned Autonomous Systems Test (UAST)
  - Overview & Mission
  - Testing Scenarios
  - UAST Topics
- Summary

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T&E/S&T Program
Overview

Mission: Develop Technologies Required to Test Future Warfighting Capabilities

- Established in FY02
  - Joint DDR&E / DOT&E Initiative
  - Transitioned to TRMC in FY05
- RDT&E Budget Activity 3 funds
- Purpose
  - High Risk / High Payoff R&D for Testing
  - Foster technology transition to major DoD test ranges
  - Risk reduction for test capabilities developments

80 Active Projects

- Annual Broad Agency Announcements (BAAs)
  - Academia
  - Industry
  - Government Laboratories
- Tri-Service working groups
  - Validate requirements
  - Evaluate proposals
  - Facilitate technology transition
- Central Oversight – Distributed Execution

Eight Test Technology Areas

High Speed Systems 13 Active Projects	Unmanned & Autonomous Systems 3 Active Projects	Spectrum Efficiency 14 Active Projects	Advanced Instrumentation 8 Active Projects
Directed Energy 17 Active Projects	Cyberspace 2 Active Projects	Electronic Warfare 16 Active Projects	Net-Centric Systems 7 Active Projects

FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
$94.6M	$96.6M	$92.6M	$94.0M	$95.8M	$98.4M	$100.2M

Shaping Technology into Tomorrow's T&E Capabilities

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Broad Agency Announcements

- Topics for Industry, Academia, and Government Laboratories to Propose Test Technology Solutions
- In-cycle Process
  - Declared schedule for white paper submissions (deadline)
  - Requires an allocation of available funding
  - Priority over out-cycle white papers (must be processed first)
- Out-of-cycle Process
  - White papers submitted anytime after "in-cycle" deadline
  - Offerors "highly encouraged" to contact Executing Agent before submitting white paper
    - Ensures interest
    - Can address whether a 'chance' exists for funding
- All BAAs include an "Other Test Technologies" topic to enable offerors to propose test technology developments that were not previously identified by the Government

All T&E/S&T BAAs are always open for new white papers

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Broad Agency Announcement (BAA) Project Selection Process

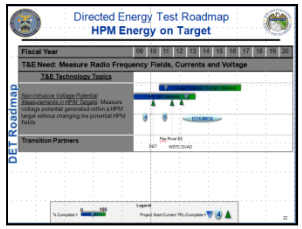
Drivers

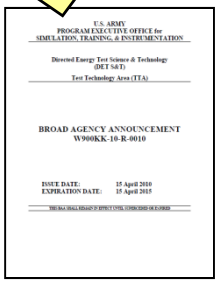
TTA Tri-Service Working Group

- Executing Agent (EA)
- T&E Community Reps
- S&T Community Reps
- Subject Matter Experts

Needs/Requirements

Announcements issued via http://www.fbo.gov





Topics and Announcements

Open to All: White Papers

Invited: Proposals

Source Selection Evaluation Team

- Source Selection Evaluation Board (SSEB)
- Subject Matter Experts
- Contracting Reps

Executing Agent Recommendations

PM

Approvals

PEO STRI

Contract Awards

Test Technology Area (TTA) Execution

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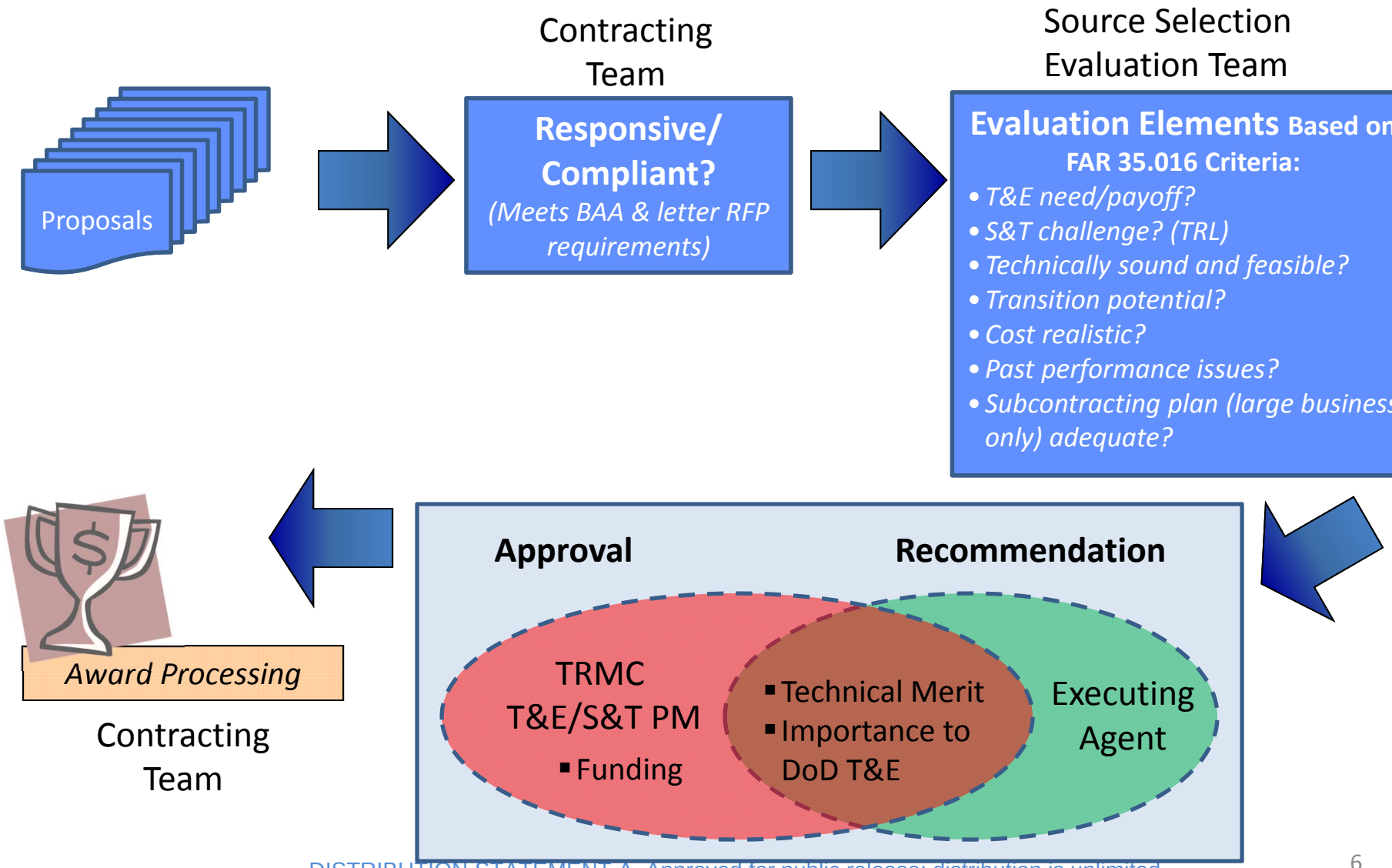
Proposal Review Process



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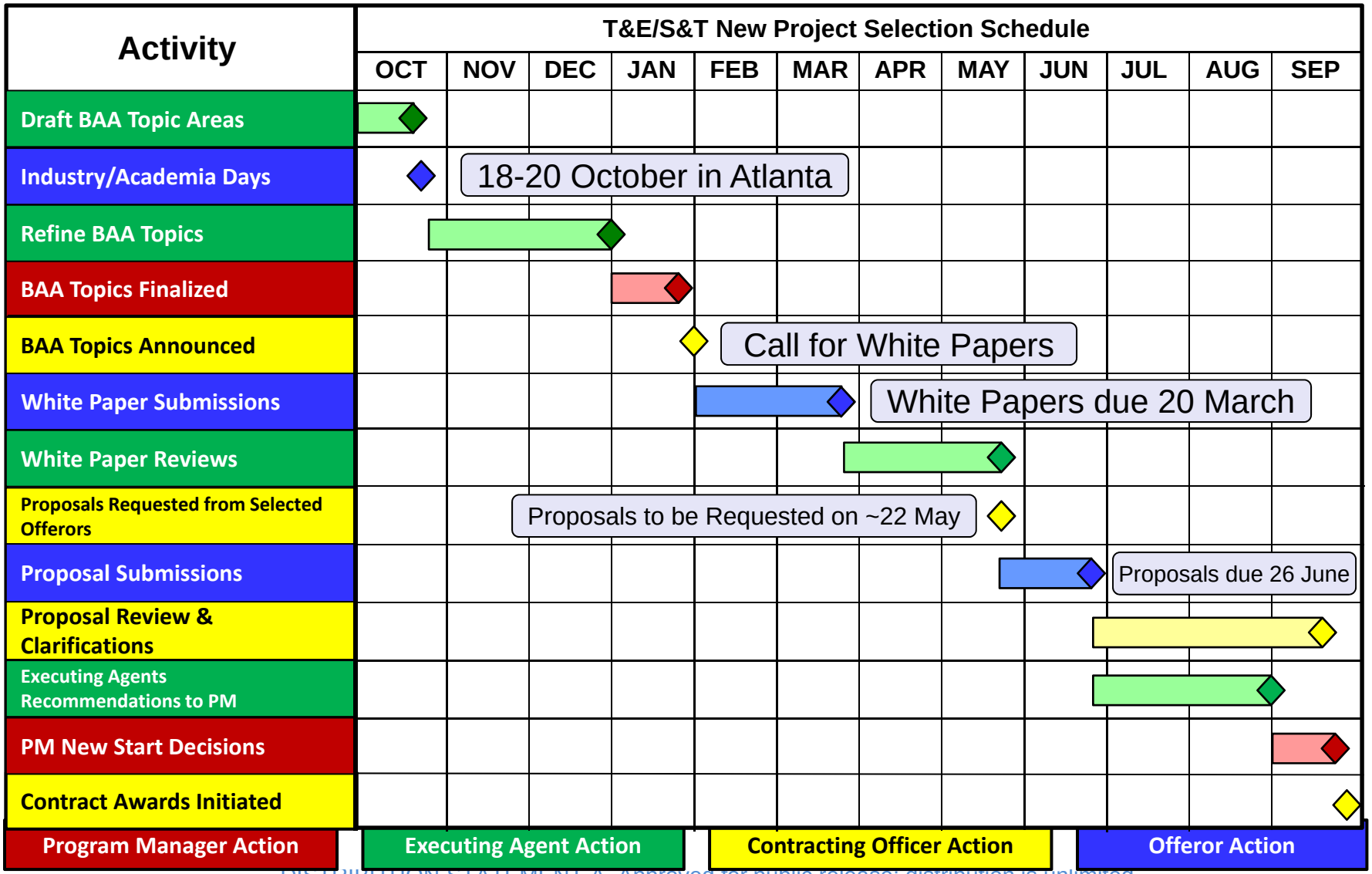
T&E/S&T New Project Selection Schedule



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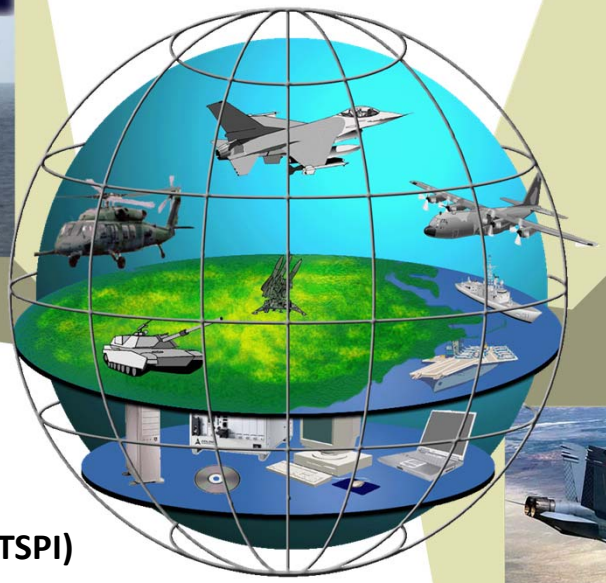
Advanced Instrumentation Systems Technology Mission



I. Time, Space, Position Information (TSPI)
II. Advanced Sensors
III. Advanced Energy & Power Systems
IV. Non-Intrusive Instrumentation
V. Range Environmental Encroachment
VI. Human Systems

Decrease size, weight & power (SWaP)

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AIST TTA Overview

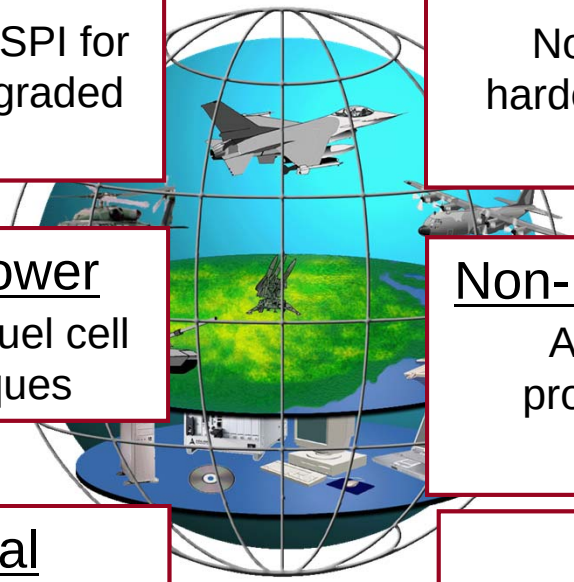
AIST will advance the field of device physics by investigating innovative materials, MEMS sensors, advanced platform-level data management, human systems integration, range environmental encroachment and novel sensor packaging technologies to support T&E of warfighting systems

TSPI

High accuracy & continuous TSPI for high speed/high-G & GPS-degraded environments

Advanced Sensors

Non-Intrusive, miniature and hardened for harsh environments



Advanced Energy & Power

Next generation hybrid ionic, fuel cell based & harvesting techniques

Non-Intrusive Instrumentation

Advanced data acquisition, processing, mining, & storage

Range Environmental Encroachment

Unique test technology of high interest

Human Systems

Man-machine interface & cognitive workload assessment

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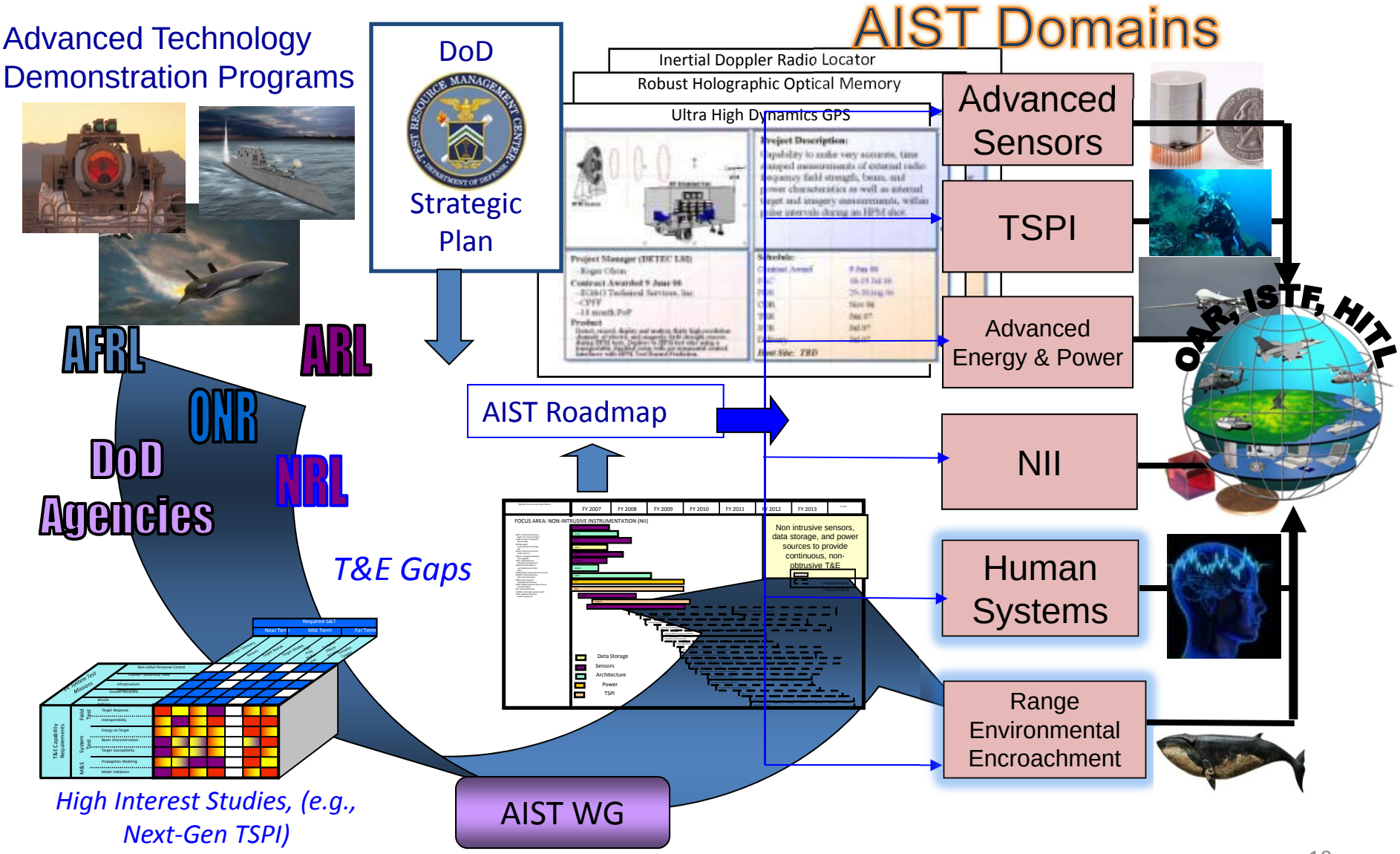
AIST Process



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AIST Advanced Sensors Topics

1. Body Armor Blunt Trauma Evaluation
2. Angle of Incidence/Stores Separation Measurements
3. Advanced Optical and Acoustic Instrumentation
4. Station Keeping Buoys for Sea Ranges
5. Warfighter/Weapon Position and Orientation
6. Weapon System Orientation
7. Supercavitating Vehicle Cavity Sensing
8. Non-traditional Sensors
9. Munition/Warhead Characterization Testing

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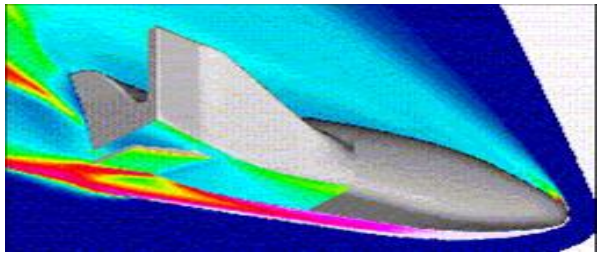
Advanced Instrumentation Systems Technology
Advanced TSPI Operational Constraints

- Emerging challenges for Time-Space-Position Information (TSPI) instrumentation
  - Test operations in GPS-blocked environments (urban, caves, dense foliage, undersea)
  - Operation in a tactical GPS-jamming environment
  - Hypersonic vehicles in a plasma field
  - Micro autonomous systems
  - Low Observable (LO) Systems that can not mount external instrumentation



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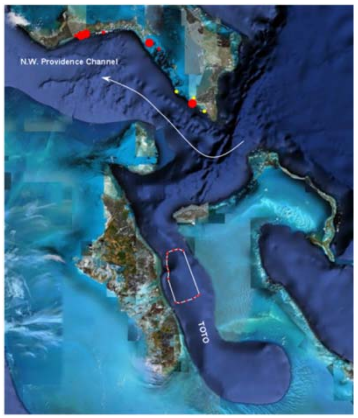
Domain: Range Environmental Encroachment

Marine Mammal Effects from T&E on Ocean Ranges (METEOR)

Naval Undersea Warfare Center, Newport, RI



Blainville's Beaked Whale
(Mesoplodon densirostris)

FY12 Accomplishments

✓Developed an initial prototype Blainville's beaked whale forage/buzz click detector/classifiers

✓Identifying candidate odontocete & baleen classifiers/feature sets

❑ Develop candidate classifiers and data sets for baleen whales

Deliverables

❑Working real-time classifiers for beaked and candidate small odontocete and mysticete species implemented on Navy ranges

Description – Determine features and establish statistics for detection and classification of beaked whale buzz clicks and selected small delphinid and baleen species

- Develop real-time detection/classification algorithms that can efficiently monitor 200 hydrophones @ 96 kHz.
- Demonstrate performance *in-situ* on Navy T&E ranges

Current Status – Phase I data collection establishing feature sets and development of classifiers to support laboratory algorithm testing

Transition Partner / Date

Navy Ranges (AUTEC, SCORE, PMRF)/4th QTR FY14

Start / Finish: Aug 11– Aug 14

Key Future Events / FY12 Plans

❑9-10 May 22, 2012: Interim Project Review, SPAWARSYSCOM, San Diego, CA

❑July 2012: Phase II decision meeting

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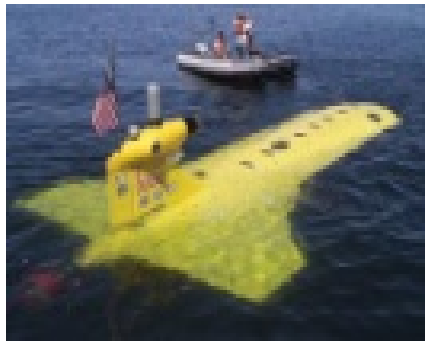
Unmanned and Autonomy Systems Test (UAST)

Mission

Develop technologies that significantly advance the science of testing autonomous and intelligent systems for operation across the full spectrum of battlespace environments

These technologies shall be pursued to enhance user's trust in system capability and operational safety



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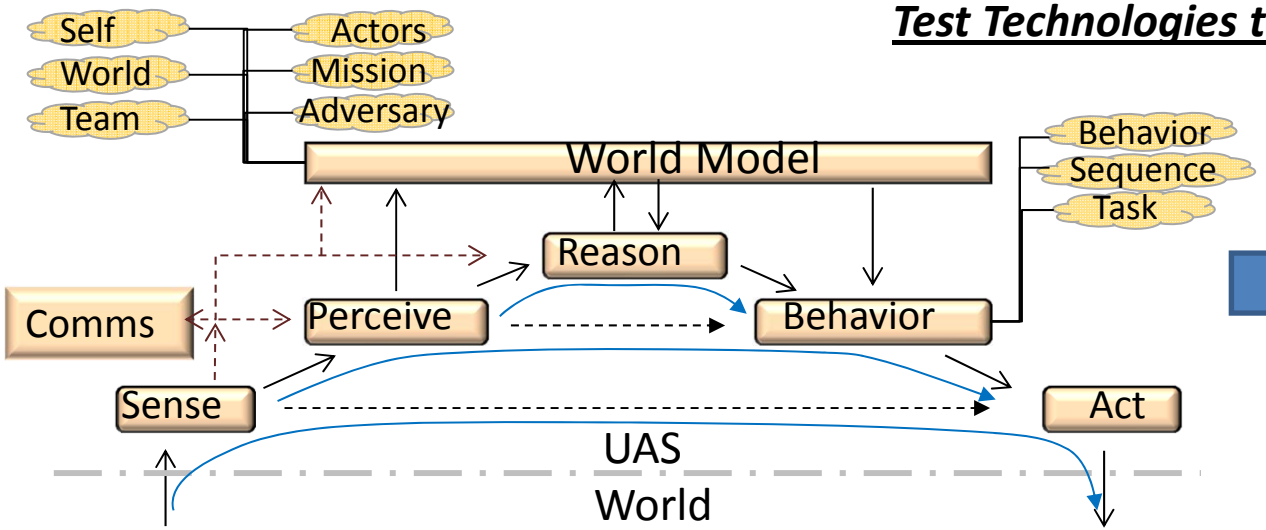
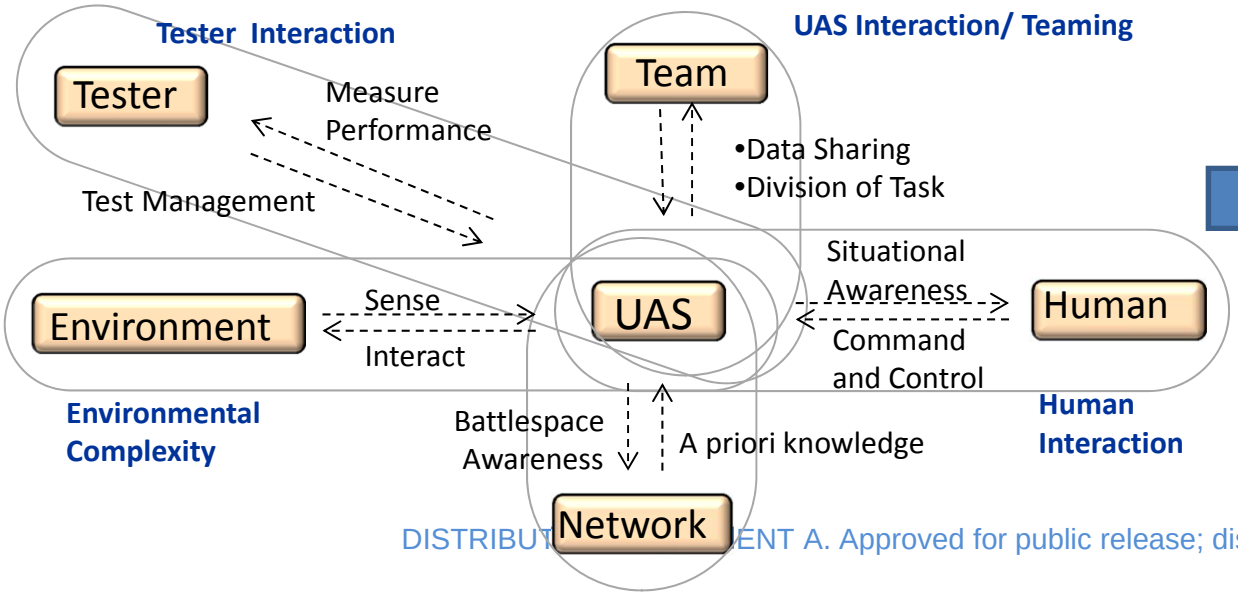
Unmanned and Autonomous Systems Test Overview

Test Technologies to Measure & Assess:



The functions of an autonomous system



The interactions of an autonomous system within its environment

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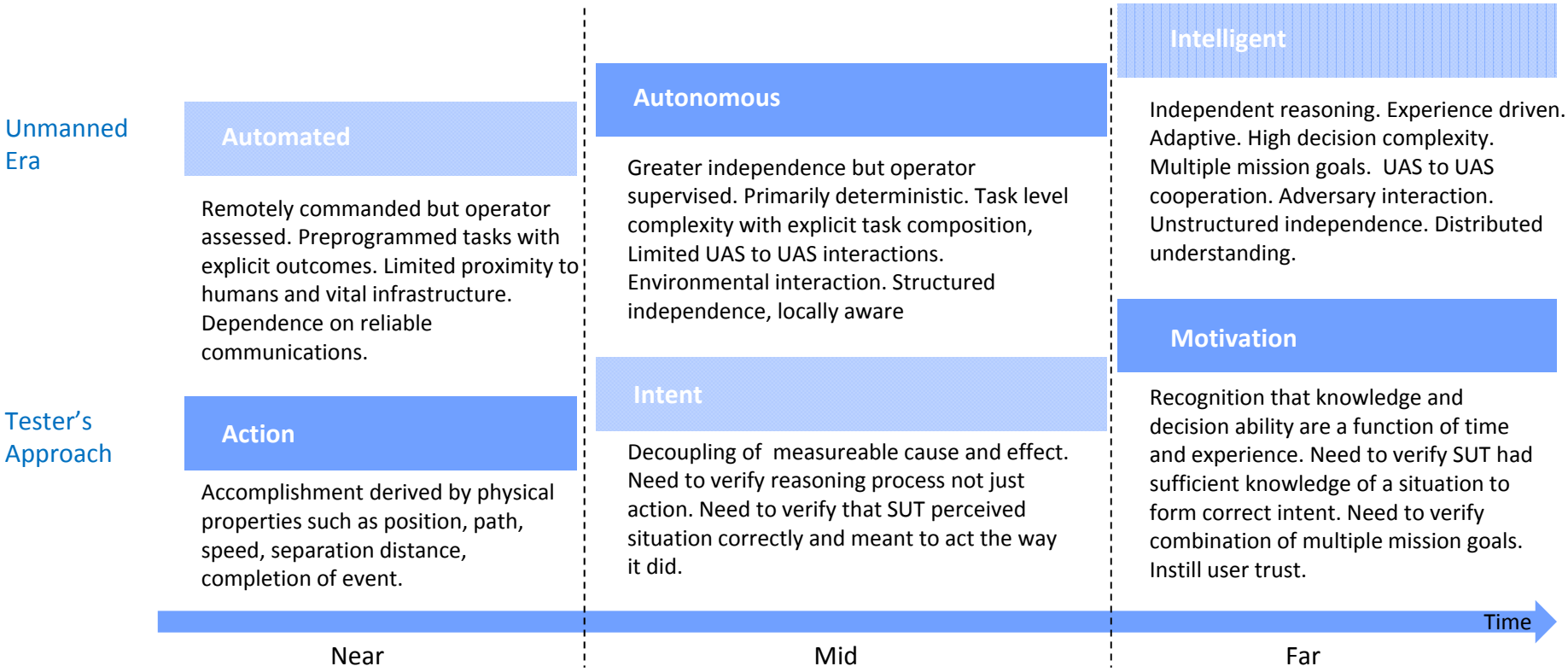
UAS Testing Eras



- UAST has identified 3 major eras of testing UAS Systems

  Automated, Autonomous and Intelligent
- Each era characterized by the approach needed to test them

  Action, Intent, Motivation
- UAST focuses on unique challenges in Autonomous and Intelligent era

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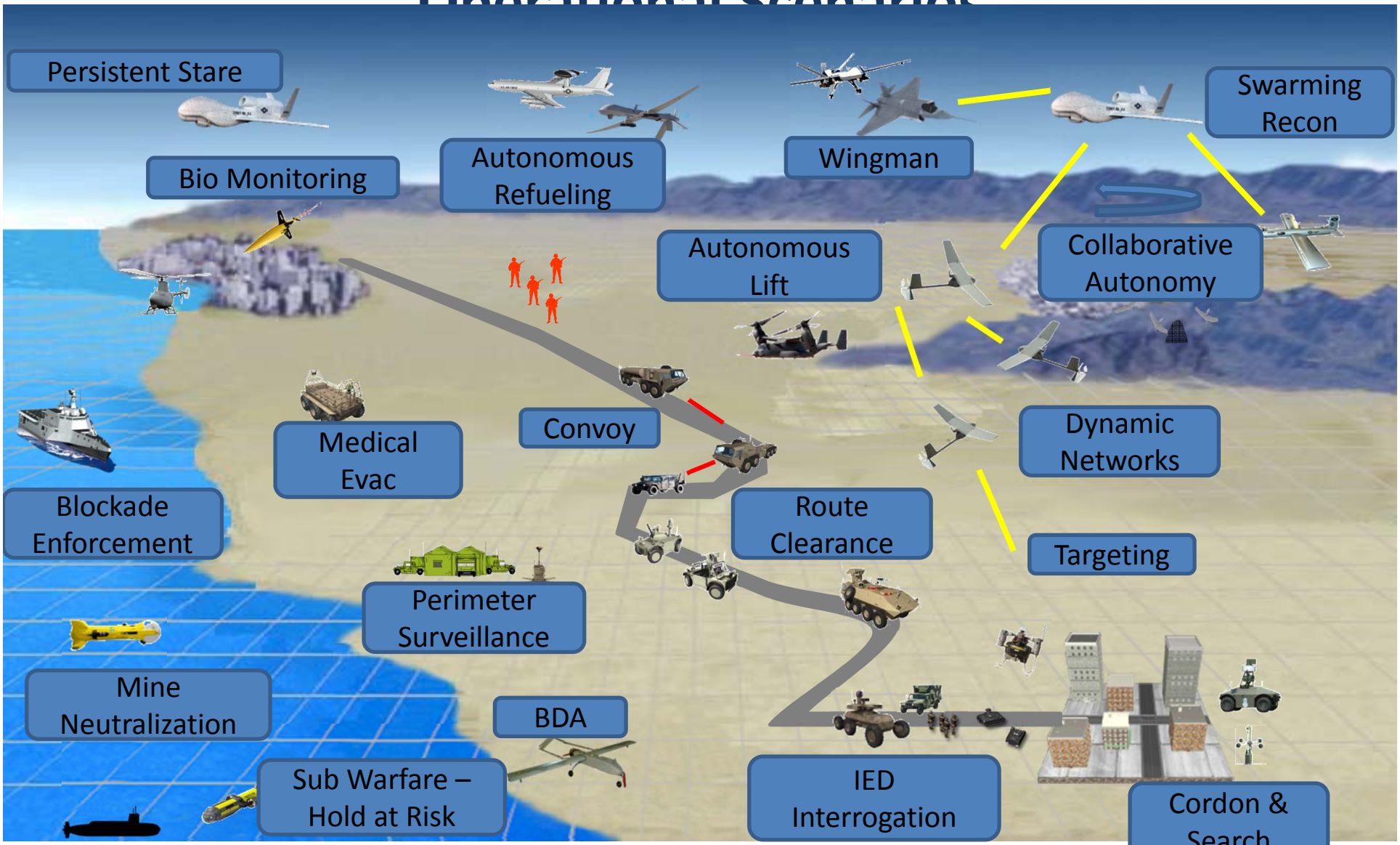
Unmanned and Autonomous Systems Test Operational Scenarios



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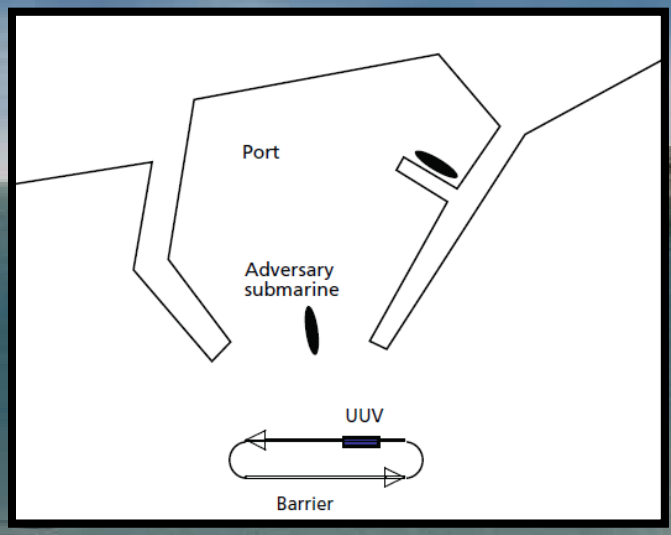
Hold at Risk

Testing failure envelops

Sea



Mission Description

- Unmanned Underwater Vehicle (UUV) launched from sub or surface ship
- Persistent forward barrier, port cueing function
- Must detect and trail passing contacts, handoff
- Long duration submerged monitoring and trailing

T&E Need

- Determine sets of conditions that will most likely produce failure
- Isolate stimulus that will test particular decision process
- Bind particular decision processes to a failure condition

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Adaptive Testing of Autonomous Systems (ATAS)

Description

- Utilization of Genetic Algorithm (GA) to search the performance (fault trees) of an UAS performing a specific mission to identify unsafe or failed behavior

Technology will identify and populate a data base of failure scenarios that represent the operational bounds of an autonomous platform (air, sea, ground)

T&E Needs

- Ability to characterize performance envelop of autonomous systems
- Understanding of how to assess autonomous operations

S&T Challenges

- Generalized representation of UAS fault rules, evaluation functions
- Scaling GA up to represent complex UAS, lengthy missions

Key Events, Deliverables, & Current Status

Phase I – 12 Months, in Progress

- Develop generalized (multiple UAS) representations of fault rules and evaluation function
  - Deliverable - Software and Application Program Interface document

Phase II – 12 Months

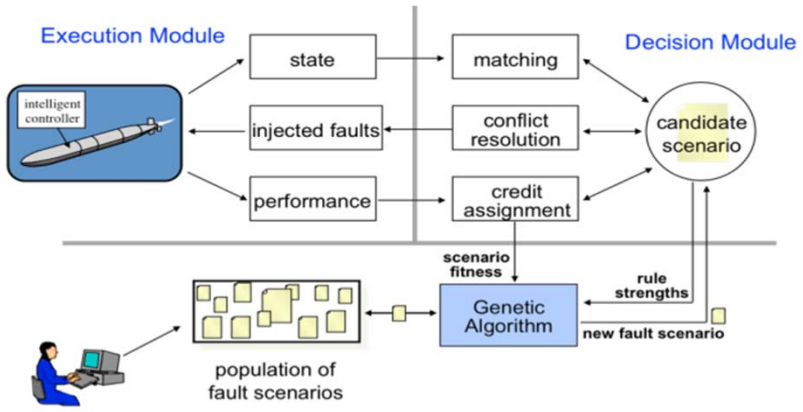
- Demonstrate on initial auto controller for Navy Large Displacement–Unmanned Underwater Vehicle (LD-UUV)
  - Deliverable - Report and demonstration on missions with multiple autonomous systems

Phase I – 12 Months

- Demo on full scale LD-UUV simulator
  - Deliverable – Software user manual
- Current Status: Project Award on 14 Jun 11. Held kick-off meeting on 20 Jul11 at NRL, spoke with Mr. Schultz for update on models being developed

Transition Partners

LD-UUV, Naval Undersea Warfare Center Keyport



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UAST Test Technology Topics

Autonomous System Test Planning

T&E Need: Ability to rapidly plan and execute an effective and efficient test strategy of an autonomous system

1. **Predicting Autonomous Behavior for Testing**
2. **Rapid Design of Autonomous System Test Plans**
3. **Enhancing Safety of Autonomous Testing**

Autonomous System Performance Assessment

T&E Need: Ability to assess the performance of an autonomous system interacting in its operational environment

1. **Measure Human-Autonomous System Interaction**
2. **Testing of Autonomy Functional Components**
3. **Measure Autonomous System Reliability and Performance**
4. **Assess Vulnerabilities of Autonomous Systems**

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T&E/S&T Program Summary

- **T&E/S&T Program initiated to address critical T&E needs tied to S&T drivers**
  - Advancing the state of the art in T&E technologies
- **The only DoD S&T program dedicated to T&E**
- **Broad Agency Announcements (BAAs) to Industry, Academia, and Government Laboratories to address test capability needs**
- **Competitive technology developments to get the best technologies possible to the test community**
- **Focused on transition into needed test capabilities**

Looking Ahead, Responsive, and Agile

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FY13 BAA Advertisements

- **W900KK-09-R-0037 AMENDMENT 0003**

TTA – Advanced Instrumentation Systems Technology Science & Technology (AIST S&T) formerly Non-Intrusive Instrumentation Science & Technology (NII S&T), Annual Update for FY13

FBO: https://www.fbo.gov/index?s=opportunity&mode=form&id=adf5700c812d47aa69091d8f3e7a8889&tab=core&_cview=1

ASFI: https://acquisition.army.mil/asfi/solicitation_view.cfm?psolicitationnbr=W900KK09R0037

- **W900KK-09-R-0038 AMENDMENT 0004**

TTA – Unmanned and Autonomous Systems Science & Technology (UAST S&T), Annual Update for FY13

FBO: https://www.fbo.gov/index?s=opportunity&mode=form&id=1dbde5d93884c3a9caf07a739720b7fe&tab=core&_cview=1

ASFI: https://acquisition.army.mil/asfi/solicitation_view.cfm?psolicitationnbr=W900KK09R0038

Points of Contact

T&E/S&T Program

George Rumford
Phone 571-372-2711
george.rumford@osd.mil

- **Unmanned and Autonomy Systems Test (UAST)**
- Executing Agent
  - Bill Hamel
  - 301-342-6373
  - william.hamel@navy.mil
- Deputy Executing Agent
  - Stephanie Riddle
  - 301-342-8475
  - stephanie.riddle@navy.mil

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  - George Shoemaker, Ph.D.
  - 401-832-5304
  - george.shoemaker@navy.mil
- Deputy Executing Agent
  - Tom Fulton
  - 401-832-6076
  - thomas.fulton@navy.mil

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