



# PARTICIPANTS and TECHNOLOGIES



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## CROSS-DOMAIN COMMUNICATIONS and COMMAND & CONTROL

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## CROSS-DOMAIN COMMUNICATIONS and COMMAND & CONTROL



Welcome to NUWC Newport's second Annual Naval Technology Exercise (ANTX)!

We are pleased to host the latest naval technologies from industry, academia, and the Navy's laboratories. ANTX 2016 provides an unmatched opportunity to demonstrate in-water technologies and collaboratively help them evolve before their introduction to the Fleet. Together, we can help achieve DoD's goals by accelerating the technology development cycle from concept to in-water testing. Rapid prototyping and speed-to-fleet development are the primary ANTX goals, and are made possible thanks to your participation.

ANTX 2016 includes technologies from 22 participants, showcasing projects that represent this year's theme: "Cross-Domain Communications and Command & Control." The technologies represent the culmination of years of research and development. Working collaboratively, we can create innovative, efficient, and effective solutions to the Navy's most pressing technological challenges. In addition, many more outstanding research projects are showcased on posters in the "Hilltop Tent" at our main campus and at our "Bayside Tent" at Stillwater Basin. We encourage you to stop by, ask questions, and learn more about what could be the Navy's next game-changing ideas.

Our Narragansett Bay Test Facility can accommodate large-scale events like ANTX as well as smaller research projects and test operations. This range facility provides unique access to bottom-mounted sensors, a portable tracking range, secure high bays, office and conference space, a boat ramp, cranes, as well as engineering and dive personnel – all of which will be integral parts of our event this week.

We encourage you to take full advantage of this opportunity to learn more about the latest technologies; meet the scientists, engineers, and technicians behind the projects; and share ideas to ensure undersea superiority. Thanks for attending ANTX 2016!



CAPT Geoffrey G. deBeauclair, USN  
Commanding Officer, Acting

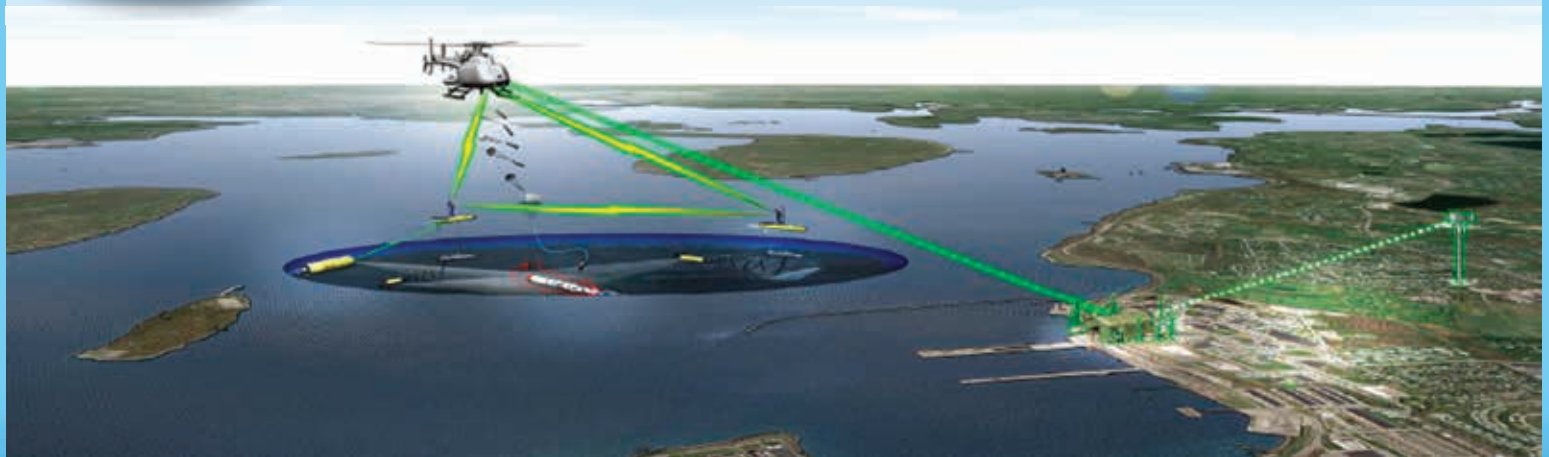


Mary S. Wohlgenuth, SES  
Technical Director





## CROSS-DOMAIN COMMUNICATIONS and COMMAND & CONTROL



# Cross-Domain Autonomous System Collaboration Anti-Submarine Warfare (ASW) Detect-to-Engage

*Exercise Lead: Northrop Grumman*

Collaborative autonomous systems for ASW enable cross-domain detect-to-engage capability while maintaining humans-in-the-loop for key decisions. Northrop Grumman will demonstrate this capability using multi-domain autonomous platforms equipped with networked sensors and advanced mission management for command and control.

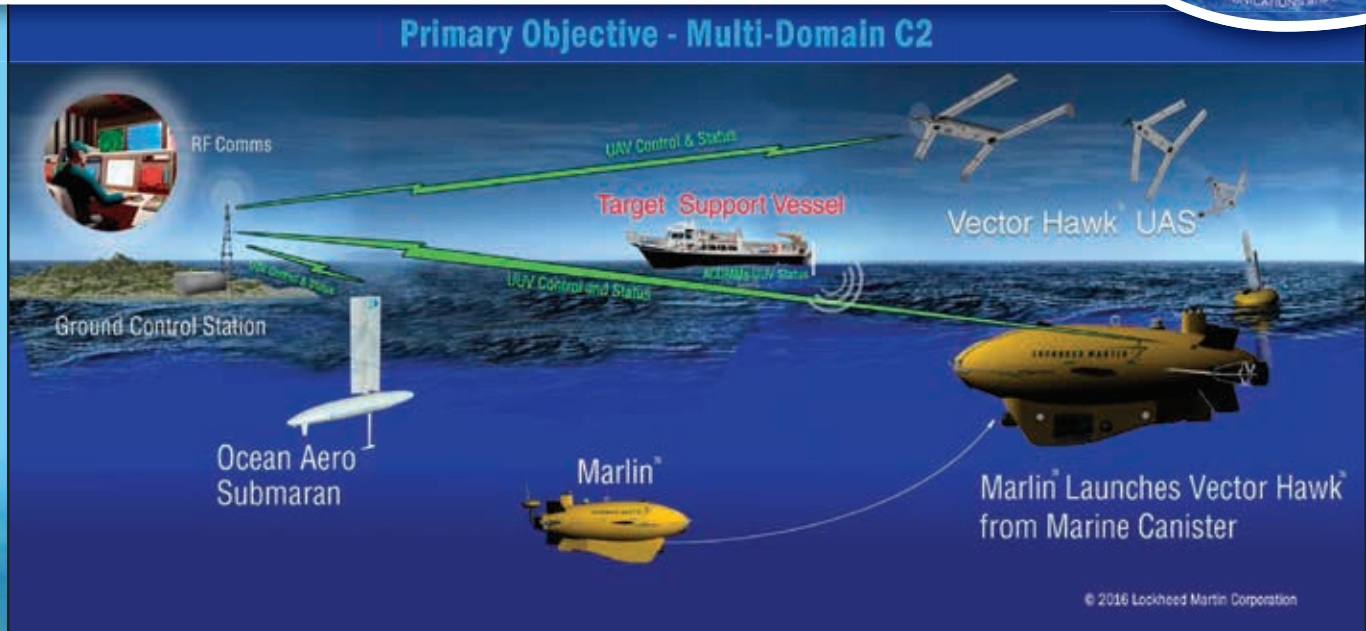
### ***Technologies Demonstrated:***

Advanced Mission Management and Control System (AMMCS) | Wave Gliders with acoustic sensors and RF gateway | REMUS with 3D bathymetric sensor | Compact Rapid Attack Weapon (CRAW) deployed from Fire Scout demonstrator | Joint Architecture for Unmanned Systems Standards (JAUS) | TOPSIDE | Maritime Open Autonomy Architecture

**For more information, contact Mr. Tom Wears  
410-765-7208, [thomas.wears@ngc.com](mailto:thomas.wears@ngc.com)**

## CROSS-DOMAIN COMMUNICATIONS and COMMAND & CONTROL

### Primary Objective - Multi-Domain C2



## Common Air, Surface, & Subsea Control System Exercise

*Exercise Lead: Lockheed Martin*

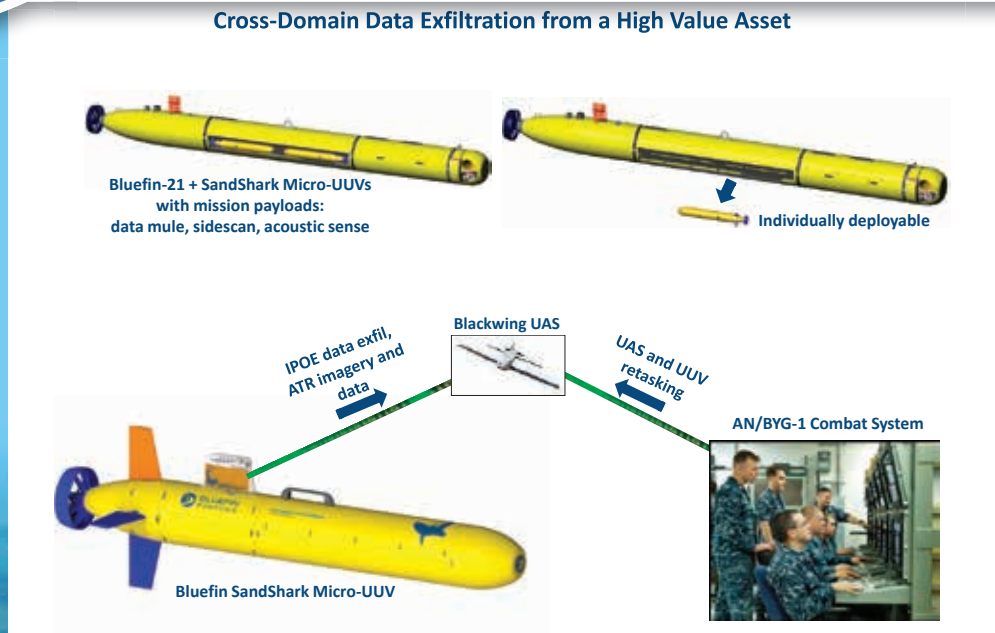
Lockheed Martin's autonomous systems are used across the globe and across the operational domains of space, air, land, sea, and undersea. Coordinated command and control of these varied and numerous cross-domain assets is required to support the current and emergent needs of the nation.

At the Annual Naval Technology Exercise at NUWC Newport in 2016, Lockheed Martin will execute, in partnership with NUWC Newport and Ocean Aero, a variety of operations with next generation systems using cross-domain command and control from a single operator control station.

**For more information, contact Mr. Adam Schrank  
561-494-2093, [adam.l.schrank@lmco.com](mailto:adam.l.schrank@lmco.com)**



### Cross-Domain Data Exfiltration from a High Value Asset



**GENERAL DYNAMICS**  
Mission Systems

**BLUEFIN**  
ROBOTICS

## UUV Delivery of a Fleet of Micro-UUVs

*Exercise Lead:* General Dynamics Mission Systems/Bluefin Robotics Products

General Dynamics Mission Systems will demonstrate Bluefin Robotics' multiple Unmanned Underwater Vehicle (UUV) "system-of-systems" concept, consisting of a Bluefin-21 carrier UUV equipped with multiple Bluefin SandShark micro-UUVs.

A Bluefin-21 will simulate collecting data, transferring key Automatic Target Recognition (ATR) fragments to a SandShark UUV to serve as a data mule, and exfiltrating the data via Blackwing Unmanned Aerial Vehicle (UAV) to the AN/BYG-1 combat system.

The Bluefin-21 provides high accuracy navigation and long endurance ingress/egress capabilities for multiple SandShark UUVs. Once on-station, individual micro-UUVs can play numerous roles, including serving as data mules, surface gateways, or enabling simultaneous spatial sampling on a broad scale.

**For more information, contact Dr. Christopher Murphy**  
**617-715-7039, [cmurphy@bluefinrobotics.com](mailto:cmurphy@bluefinrobotics.com)**



## Magneto Inductive Technology for UxV COMMS

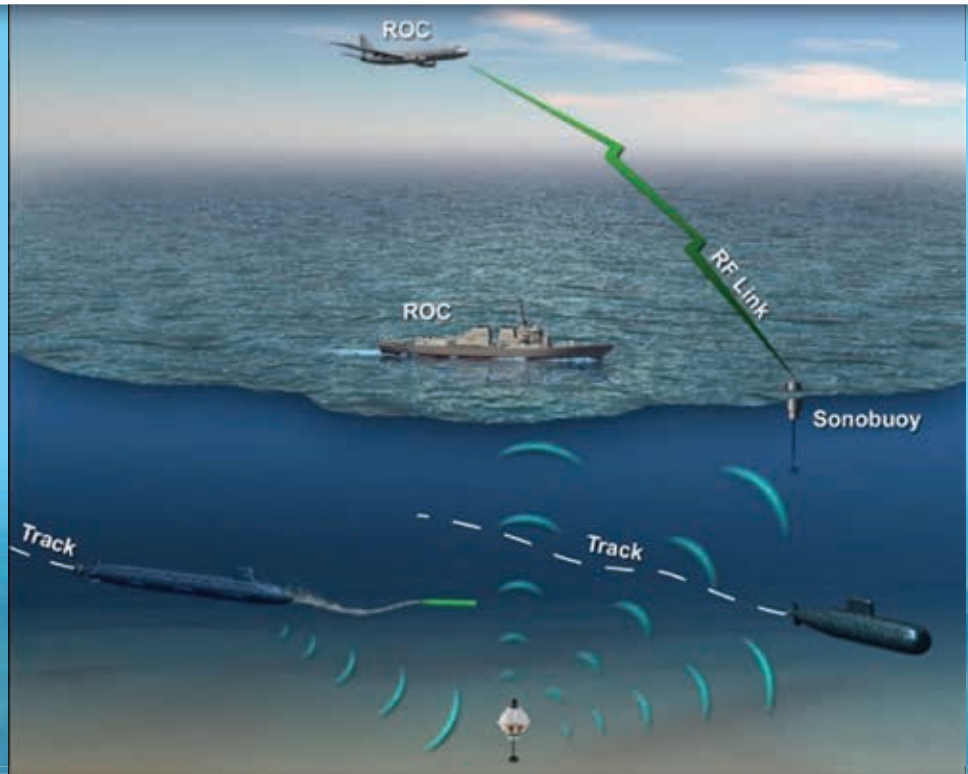
*Exercise Lead: Ultra Electronics EMS*

Ultra Electronics EMS has developed and fielded three technologies (DiverComm, Rock Phone, and TerraComm) that utilize low-frequency magnetics to communicate through media such as rock, soil, and seawater. These products have several advantages, one of which is the system works both above and below water simultaneously, and another that it is difficult to jam or eavesdrop. These products are already used as stated in the product brochures by special forces and mine rescue groups.

Ultra Electronics EMS is demonstrating some product enhancements to the existing DiverComm product, and demonstrating a communications system that can be mounted on a Unmanned Underwater Vehicle (UUV) at ANTX. Ultra Electronics EMS will also be working collaboratively with NUWC Newport's dive team using DiverComm System throughout ANTX in order to evaluate its utility in Navy operations.

**For more information, contact Mr. Robert Tims  
631-721-8137, [bob.tims@ultra-ems.com](mailto:bob.tims@ultra-ems.com)**





## Submerged Acoustic Navigation System (SANS)

*Exercise Lead: MIKEL, Inc.*

SANS utilizes one or more SANS beacons to enable a vehicle to track itself while remaining acoustically passive using the Range Only Motion Analysis (ROMA) algorithm. SANS capability is integrated with the Acoustic Rapid Commercial Off-the-Shelf Insertion (ARCI) Program and is used to support submarine training and Test & Evaluation (T&E).

For ANTX 2016, MIKEL plans to demonstrate the use of SANS with an Unmanned Underwater Vehicle (UUV). A SANS beacon will be installed in the ANTX area of operation and through a collaboration with a leading UUV manufacturer, a UUV will be instrumented with a custom payload to provide a post-event track of the vehicle.

**For more information, contact Mr. David Lambert  
401-846-5821, [david.lambert@mikelinc.com](mailto:david.lambert@mikelinc.com)**





 **Digital Design  
& Imaging Service Inc.**  
[AirPhotosLive.com](http://AirPhotosLive.com)

## Aerial Monitoring of Rogue Drone Operations Near Maritime Ports

*Exercise Lead: Digital Design & Imaging Service Inc. (DDIS)*

DDIS has developed and offers the ability to loft tethered aerostats for surveillance of rouge drones around sensitive maritime ports. Our rapidly deployed surveillance balloons can be winched out from a customized command and control trailer. It can also be transferred to a winch cart and towed in using military Zodiacs. This tethered mobility provides the ability to conduct searches for rogue drones and/or locate drone pilots on the ground. Other applications include monitoring oil spills, water pollution and assisting in MOB searches. It performs best in shallow water with wind speeds under 15 knots. Helium provides lift for up to 10 lb payloads to 1,000 ft above mean sea level. Its long duration silent coverage is useful for surveying docking ships and other vulnerable infrastructure found near ports. Payloads have included our trademark 9-Eye, a cluster of high-resolution cameras that provide 360 degree high resolution photographic coverage with no blind spots. See samples at [www.AirPhotosLIVE.com](http://www.AirPhotosLIVE.com). Other aerial sensor payloads can include: RF Spectrum analysis sensors, acoustic sensors, 1027 resolution thermal cameras, a 5 sensor wireless aerial weather station, radiation detectors, wind pennant indicators to 1,000 ft, communication repeaters, strobes and aerial sirens.

DDIS will be providing a live demonstration of the aerostat balloon and its deployment from our custom launch trailer onshore as well as attaching the surveillance balloon to a nearby buoy/anchor.

**For more information, contact Mr. Curt Westergard  
703-534-7500, [Curt@AirPhotosLIVE.com](mailto:Curt@AirPhotosLIVE.com)**



## Portable Underwater Global Positioning System (PUG)

*Exercise Lead:* University of Rhode Island and DBV Technology, LLC

Three PUG systems will be anchored to the sea floor in an area of operations zone where other ANTX participants are operating.

The objectives of the exercise are to install a number of sea floor anchored beacons, acoustically activate the beacon, and utilize an unmanned underwater vehicle (UUV), such as the Lockheed Martin Marlin UUV and/or the Bluefin Robotics SandShark micro-UUV, to record its own navigation and acoustic hydrophone sensor data when operating submerged within hearing radius of the beacons. This data will be post-processed in order to provide a track of the UUV.

**For more information, contact Dr. Harold "Bud" Vincent  
401-714-3803, [vincentht@uri.edu](mailto:vincentht@uri.edu)**



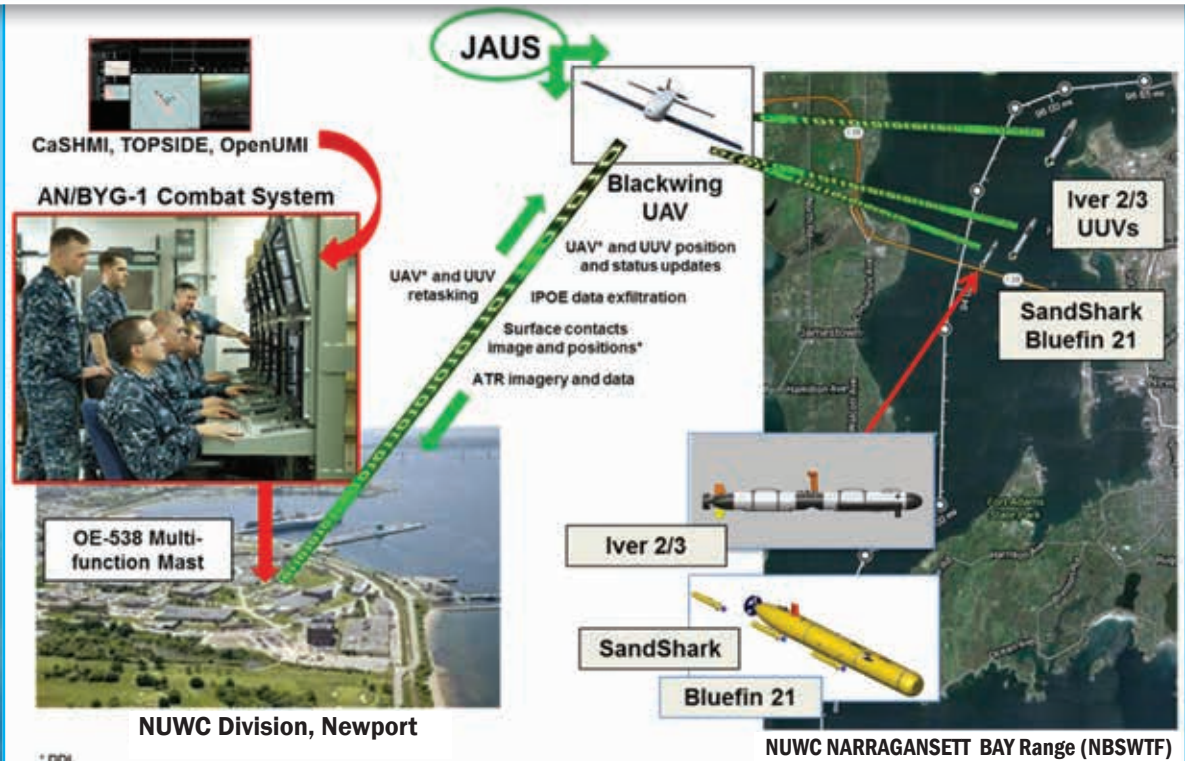


## Unmanned Surface Vehicle (USV) with Intelligence, Surveillance, and Reconnaissance (ISR)

*Exercise Lead:* NUWC Newport,  
Code 15 / Sensors and Sonar Systems

NUWC Newport will demonstrate remote ISR operations using the NUWC-4 USV with the electro-optic/infrared (EO/IR) module and radar installed. For safety purposes, a NUWC safety coxswain remains onboard the USV as an observer and can assume control during emergency conditions. During the exercise, the safety coxswain will get the USV underway from the pier and pilot it to the designated operational area. Once in position, the host (command and control) pierside station will assume remote control of the USV to demonstrate maneuver and payload operations capabilities while remaining within the operational area. The demonstration will include relaying of mission-type information to the host station pierside, where the participants will be able to observe live USV video, and the actual command and control displays.

**For more information, contact Mr. David Jardot  
401-832-2670, [david.jardot@navy.mil](mailto:david.jardot@navy.mil)**



## Submarine Combat System C2 of Cross-Domain UxVs

*Exercise Lead:* NUWC Newport, Code 25 / USW Combat Systems

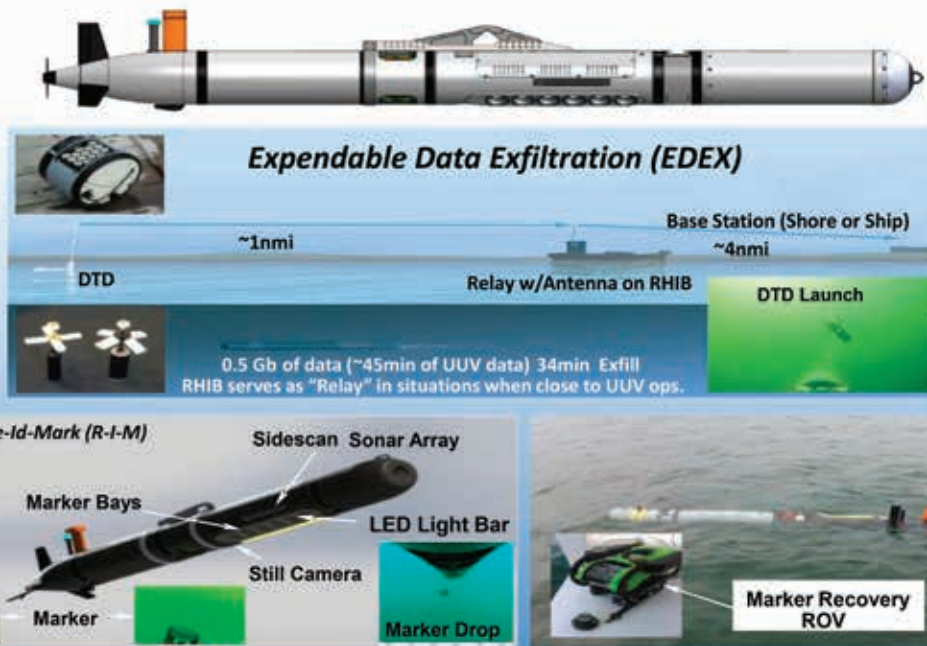
Command and Control of networked unmanned systems is critical to meeting the vision of U.S. Navy operations. This demonstration provides command and control of Unmanned Aerial Vehicles (UAV) and Unmanned Undersea Vehicles (UUV) from the AN/BYG-1 Submarine Combat System, using Fleet systems and components. Iver and Bluefin UUVs, and the Blackwing AUV will be deployed in Intelligence, Surveillance and Reconnaissance (ISR) and targeting missions, and messaging standards will support bi-directional communications with combat system operators through the submarine Multi-Function Mast. Unmanned system controllers used currently or in development for transition — Control Station Human Machine Interface (CaSHMI), Open Unmanned Mission Interface (OpenUMI), and Topside — have been integrated into the AN/BYG-1 Submarine Combat Control System to demonstrate platform and payload control of the systems, display status and tactical data relayed from the offboard platforms, and allow retasking in extended control scenarios with denied or intermittent satellite communications.

**For more information, contact Dr. Michael Incze**  
**401-832-3436, [michael.l.incze@navy.mil](mailto:michael.l.incze@navy.mil)**





## MK18 MOD 2 Increment 2



## MK18 MOD 2 Increment 2

*Exercise Lead:* NUWC Newport,  
Code 85 / USW Weapons, Vehicles, and Defensive Systems

The MK18 MOD 2 Increment 2 is a "REMUS 600" (Remote Environmental Monitoring Units) variant being developed by PMS 408 to support Explosive Ordnance Disposal (EOD) and other fleet Mine Countermeasure (MCM) missions in an effort to reduce tactical timelines and mark targets.

The MK18 MOD 2 Increment 2 material solutions include a required-identify-mark (RIM) payload with an autonomy suite to include automated placement of an acoustic marker or homing beacon. It also includes a magnetic gradiometer, camera, and embedded Automatic Target Recognition (ATR) to aid in the autonomous marker drop decision(s), as well as, an intra-mission expendable data exfiltration system (EDEX) of unmanned undersea vehicles (UUV) data back to the decision makers.

**For more information, contact Mr. Richard Bashour**  
**401-832-6074, richard.bashour@navy.mil**



# ANTX 2016

## Static Participants

### **Hydroid**

Next Generation REMUS 100 UUV

### **L-3 Advanced Programs**

Persistent Undersea Power Source (PUPS)

### **L-3 Ocean Systems**

UUV /USV Sensor Systems

### **Nanocomp Technologies, Inc.**

Revolutionary Carbon Nanotube Materials for Naval Warfare

### **PMS 485**

Shallow Water Surveillance System (SWSS)

### **Riptide Autonomous Solutions**

Riptide Micro-UUV

### **Siemens Government Technologies, Inc.**

PEM Fuel Cell Air Independent Power Generation

### **Naval Surface Warfare Center Carderock**

Unmanned Maritime Mobility Systems

### **NUWC Newport/Corporate Operations Department**

Energy Warrior

### **NUWC Newport/Sensors and Sonar Systems Department**

Next Generation Sensing

### **NUWC Newport/Ranges, Engineering, and Analysis Department**

Navy Acoustic Effects Model  
& Environmental Planning (NAEMO)

### **NUWC Newport/Undersea Warfare, Weapons, Vehicles, and Defensive Systems Department & Raytheon**

Cyber Challenge/AQS-20

### **NUWC Newport/Undersea Warfare, Weapons, Vehicles, and Defensive Systems Department**

Energy for UUV Applications

### **NUWC Newport/Undersea Warfare, Weapons, Vehicles, and Defensive Systems Department**

RPG of the Sea

### **NUWC Newport/Undersea Warfare, Weapons, Vehicles, and Defensive Systems Department**

TOPSIDE



CROSS-DOMAIN COMMUNICATIONS and COMMAND & CONTROL



# ANTX 2017

See You at  
**ANTX**  
**2017**





## Narragansett Bay Test Facility



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