HII Unmanned Systems

Developments in modular MCM technology

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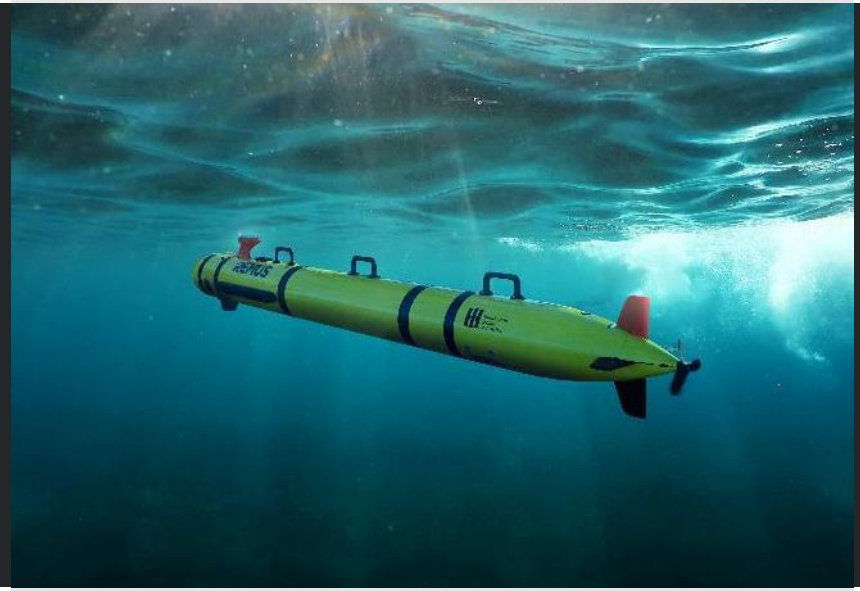
Mission Technologies

A division of HII

Unmanned Systems

World leading autonomy and multi-domain autonomous systems making vast expanses of the earth accessible for defense, research and commerce.



Capabilities:

- Unmanned Underwater Vehicles
- Design, Development, Production & Sustainment
- Advanced Autonomy Solutions
- Unmanned Surface Vessel Autonomy
- Engineering, Manufacturing & Support Services

Notable Programs:

- REMUS UUVs (REMUS 100, REMUS 300, REMUS 600, REMUS 6000)
- U.S. Navy MK18 UUV and LBS-AUV
- U.S. Navy Orca XLUUV program (Boeing partnership)
- Supplier of the man portable MCM AUV solution to Royal Navy for 20 years
- Proteus large class UUV for testing and demonstrations

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Military Customer Base

Include but not exclusive:

- Royal Norwegian Navy
- Finnish Navy
- Swedish Navy
- South African Navy
- Brazilian Navy
- Croatian Navy
- Irish Navy
- Bulgarian Navy
- Thailand Navy
- Canadian Navy
- Royal Australian Navy

- United States Navy
- Japanese Navy
- Singapore Navy
- Royal New Zealand Navy
- Ukraine Navy
- Oman Navy

- German Navy
- Royal Netherlands Navy
- UK Ministry of Defence
- NATO – CMRE
- Belgian Defence
- Italian Navy
- Estonian Navy
- Romanian Navy
- Latvian Navy

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Enhancements in latest generation of REMUS

- Now fully modular for batteries and payloads
- Open Software and Hardware Architecture
- Easy module change out
- Cyber security
- Hardware and Software Developer Kits

Why Modularity in REMUS for MCM Ops ?

- This has been a departure from the REMUS vehicles of old

Why?

- 20+ years of continuous feedback from ourexpert user community
  - Gives the system they wanted
- Allows flexibility in operational environment
- Open Architecture
  - Allows the future proofing of the operators needs
- Longer endurance if required
  - More is being asked of UUVs in more challenging environments

The Right Tool for the Right Job

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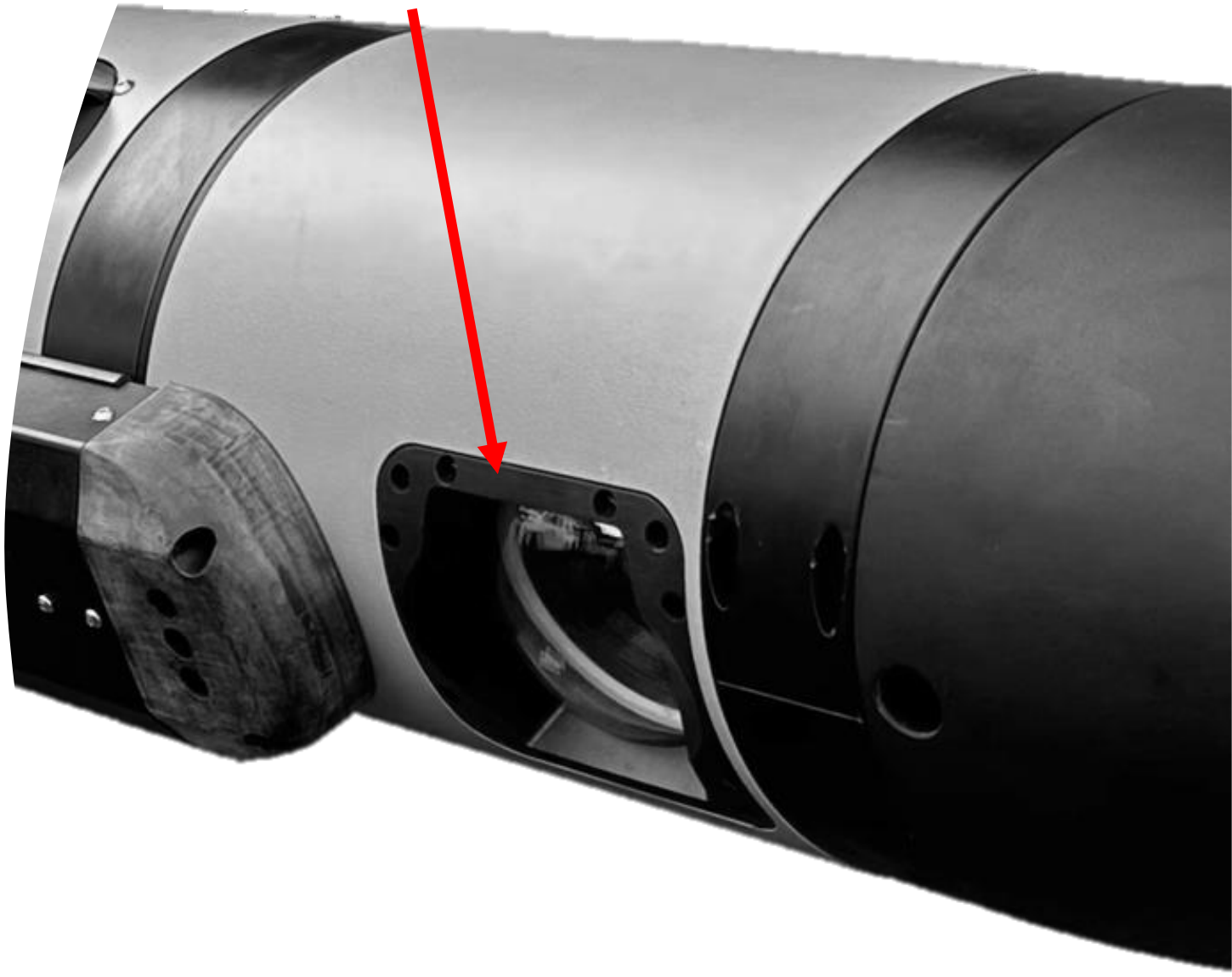
Advantages of Mission Modules for our Future Platforms

- Common modularity across platforms R100-R6000
- Multi-mission flexible platforms with rapid payload replacement
- End-user developed custom payloads for classified operations
- Energy module configuration to meet mission profile
- Flexible launch and recovery options

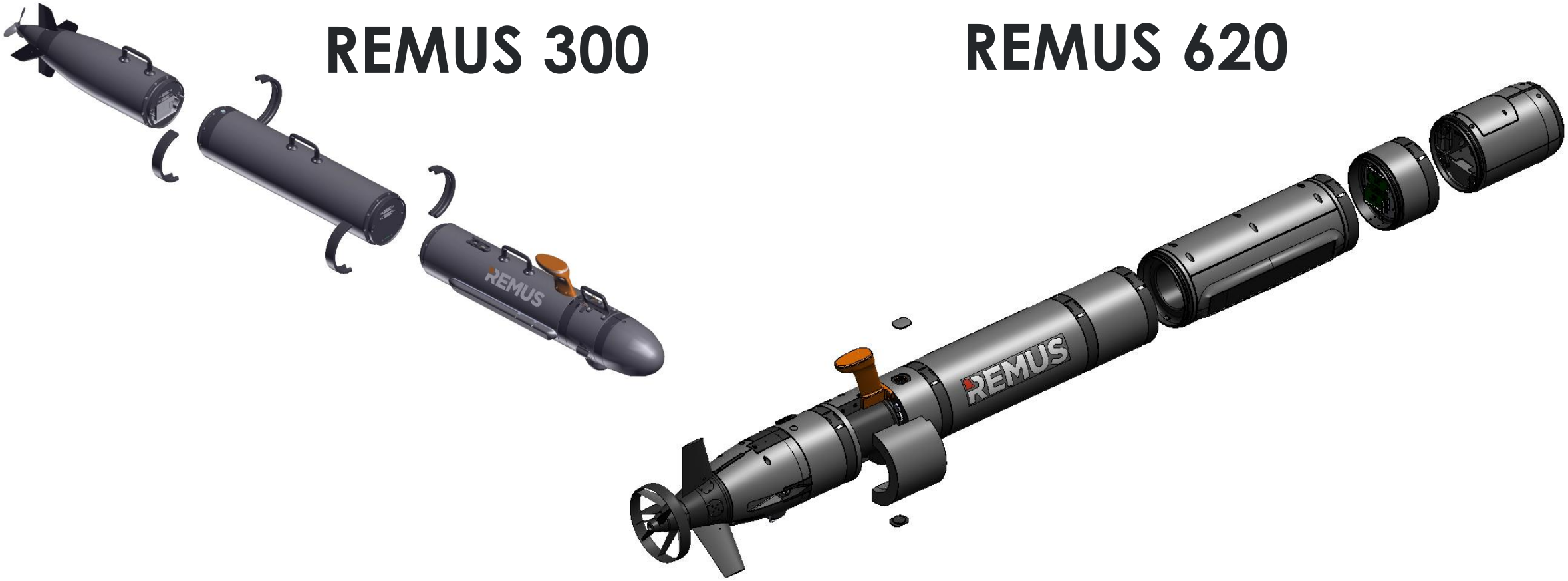
VOYIS RECON 4k Camera Module



Modular Remus MCM systems

REMUS 300

REMUS 620



Remus 300

Specifications

- Expeditionary
  - 2.03 - 2.64m long, 20.7cm diameter and 48-70kg.
  - Ship, Submarine, Shore, Helicopter, Small boat / USV operations
- Range
  - 3 swappable battery module options (1.5, 3.0 & 4.5kwh)
  - Up to 30 hrs, 120NM range
  - Max speed 5 knots
- Versatility
  - Wet and or Dry Primary Payload Modules
  - 2 Secondary Payload interfaces
  - Open Architecture Software
  - Standard Payload Interfaces
- NSA Cyber Security Capable

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Introducing REMUS 300 - Modular, Open Architecture

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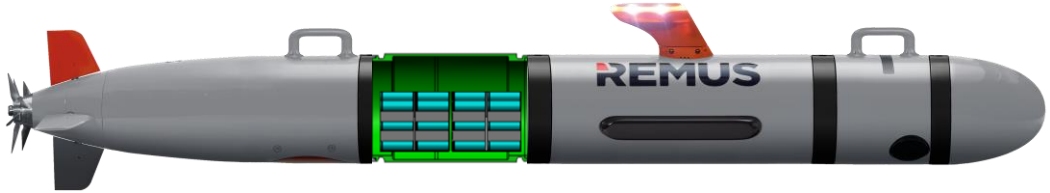
Modularity

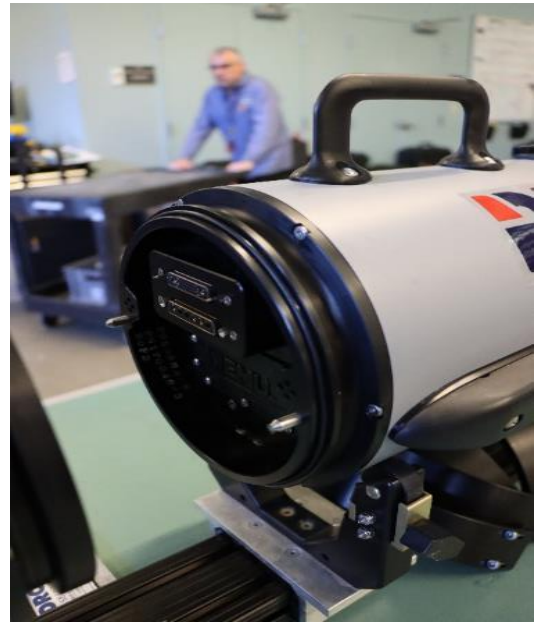
Long Endurance 4.5 KW 30 hrs at 3.2 kts

Medium Endurance 3kw and Payload 20 hrs at 3.2 knts

Base Endurance 1.5kw and Large Payload 10 hrs at 3.2kts

Basic Configuration 1.5kw (85 lbs) 12 hrs at 3.2 kts





Tool-less, at sea change out

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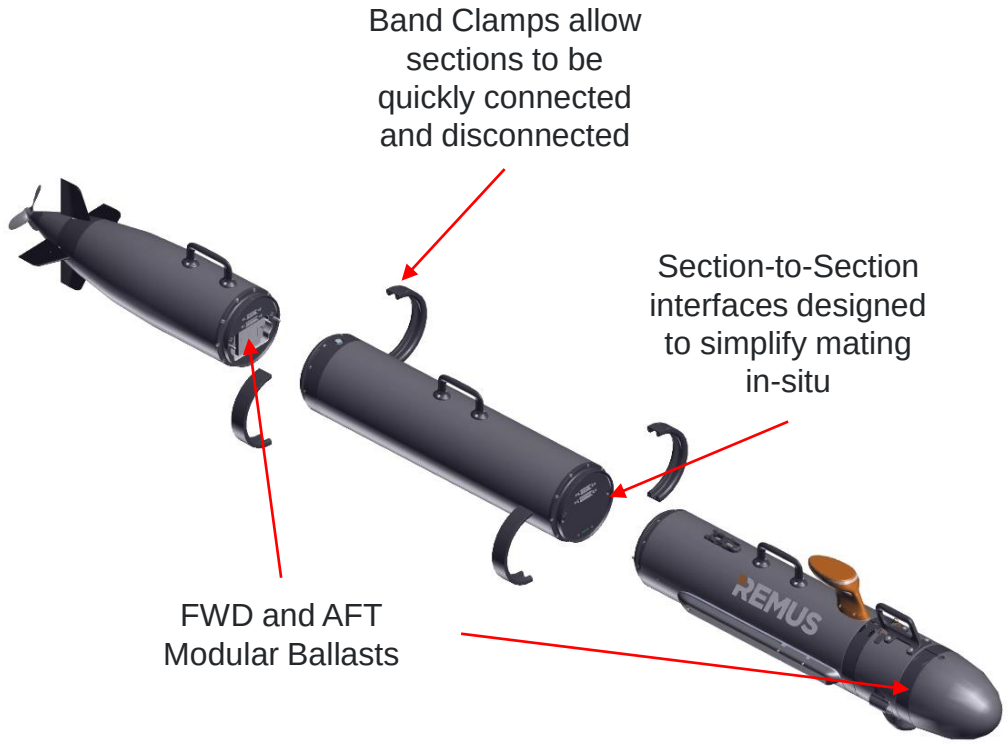
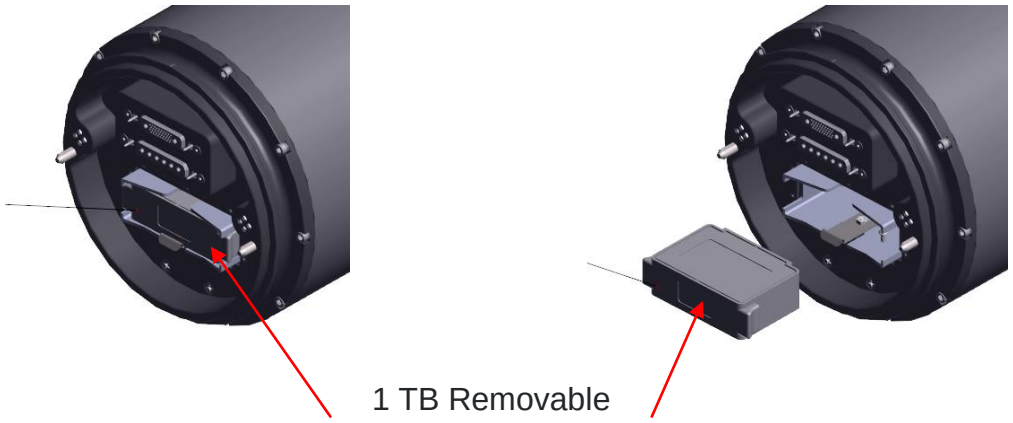
New Key Features

- Section Modularity and Flexible Ballasting across vehicle
  - Enables quick swapping of Energy Section and Removable Hard Drive to keep the vehicle in the water
    - Demonstrated complete turnaround in less than 9 minutes
  - Facilitates integration of custom payload / sensors
  - Hardware and Software Development Kits (HDK, SDK) further facilitate integration of custom payloads / sensors





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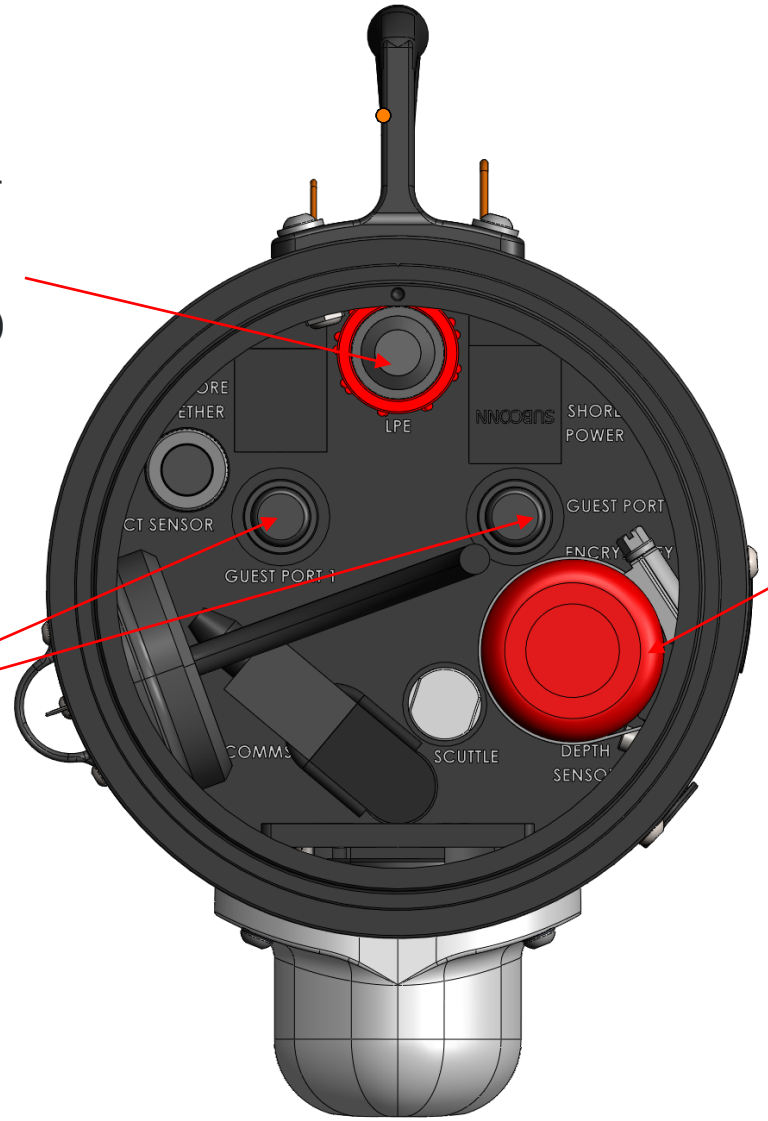
New Key Forward Endcap Features

LPE interface for high power sensors (10/100 BASE-T)

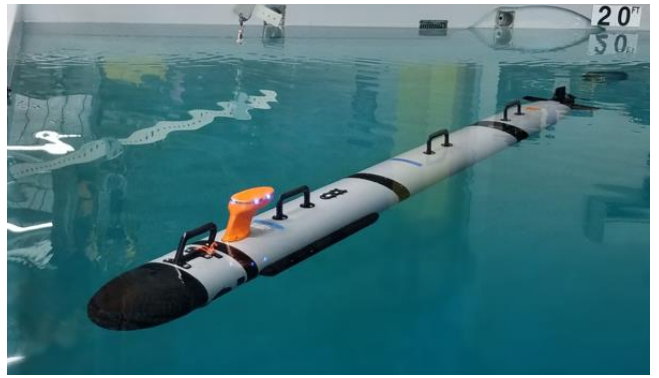


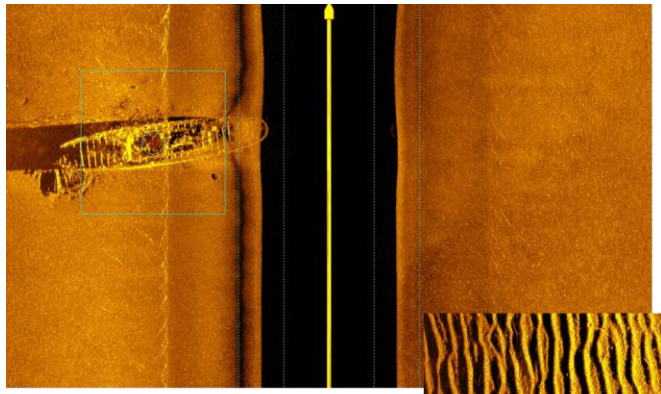
Introduction of an independent emergency pinger for location of vehicle should there be complete power failure

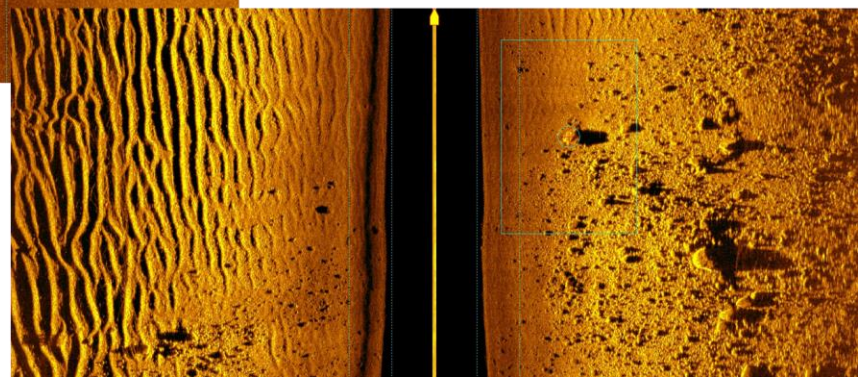
Guest Ports (x2) interfaces for legacy REMUS sensors (10/100 BASE-T)

Summary

- REMUS 300 was designed with user inputs and lessons learned from across the REMUS platform in mind to ensure customer concepts of operation are satisfied
- Reliability, manufacturability, serviceability, and maintainability improvements have been implemented to greatly benefit the end user
- Vehicle form factor allows the REMUS 300 to be two-man portable, greatly simplifying transportation and operation at mission locations
- Section Modularity and Flexible ballasting enables quicker mission turnaround to keep the vehicle in in the water
- REMUS 300 versatility is unmatched while also remaining capable of meeting or exceeding all SCUUV requirements







Remus 620

Specifications

- Expeditionary
  - 3.1 – 5.6 m long, 32.4 cm diameter and 210-411kg.
  - Ship, Submarine, Shore, Helicopter, Small boat / USV operations
- Range
  - Up to 3 in-series 9.6 kWh batteries per vehicle
  - Up to 110 hrs, 275NM range
  - Max speed 8 knots with new tail design
- Versatility
  - Wet and or Dry Primary Payload Modules
  - 2 Secondary Payload interfaces
  - Open Architecture Software
  - Standard Payload Interfaces
- NSA Cyber Security Capable

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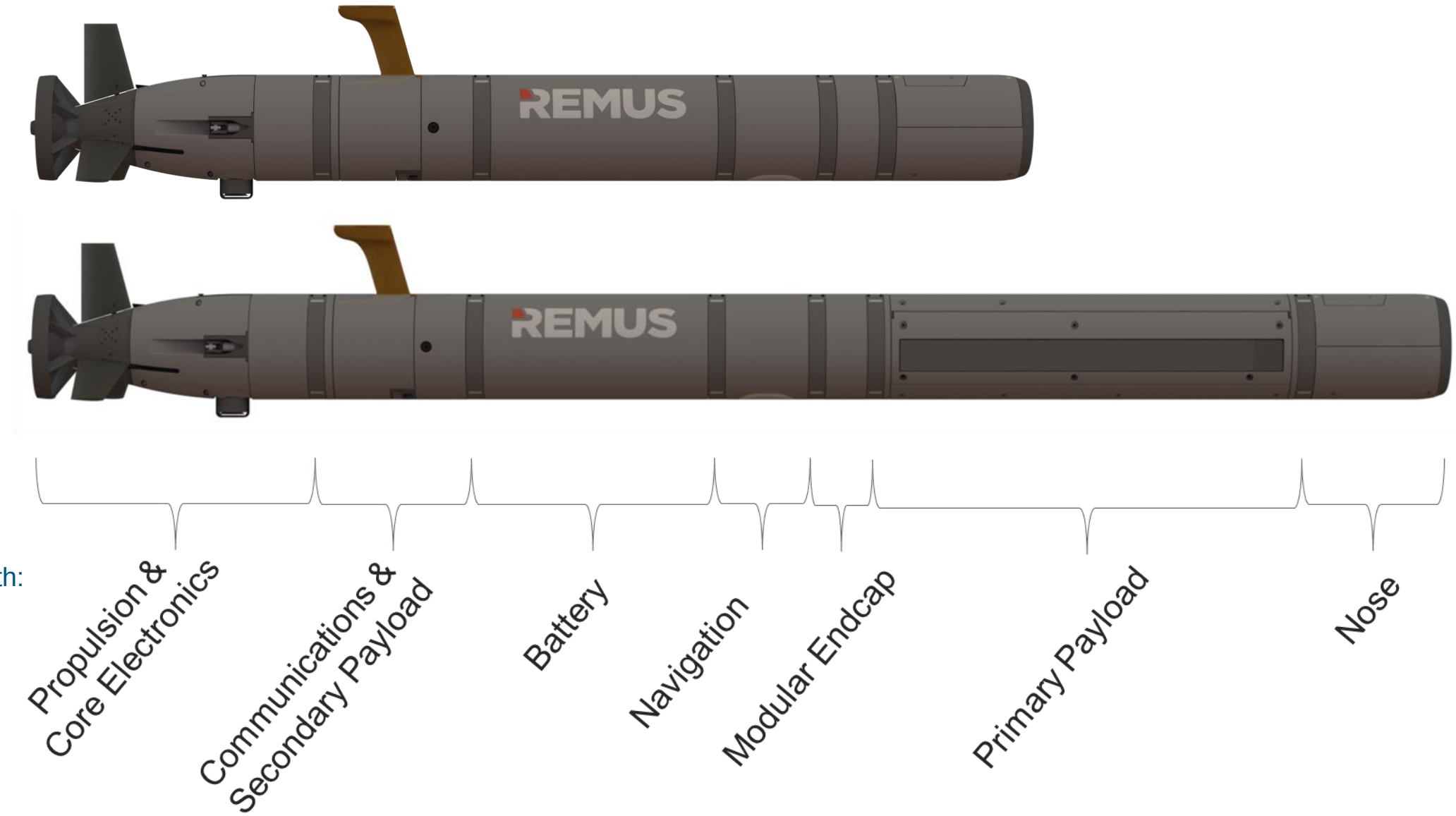
Vehicle Overview

Base Vehicle:
1 battery, No payload
- Length: ~123” / 3.1m
- Weight: ~500 lbs / 222kg
- Dia. 12.75”/32.4cm

MINSAS 120 Vehicle:
1 battery
- Length: ~170” /4.3m
- Weight: ~625 lbs/284kg

Vehicle options:
1-3 batteries + payloads
- Recommend Max Length: ~215”/5.4m
- Max Weight: ~1000 lbs +/450kg



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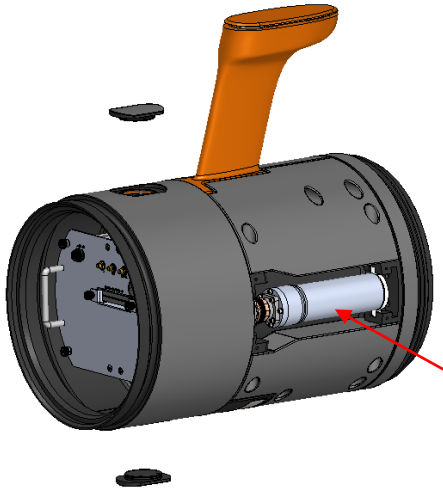
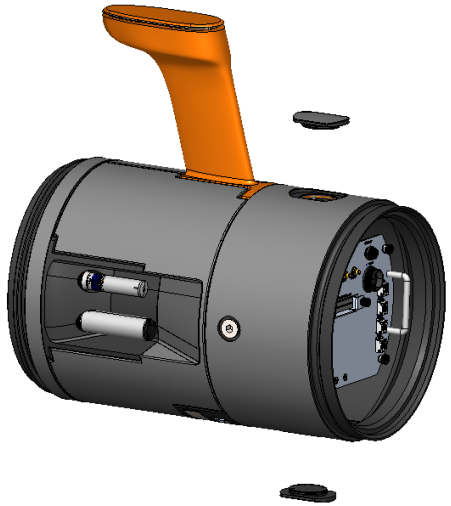
New Communications

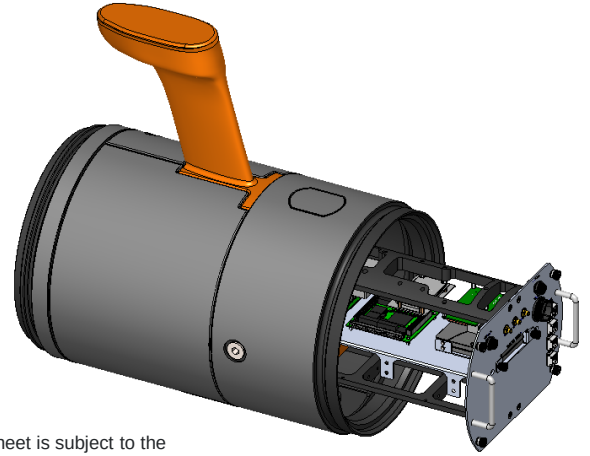


Optional External Hard Drive *



- Redesigned Antenna
  - L1/L2 GPS, Iridium, WiFi, Cellular Antenna
  - Integrated LED/Visible/Infrared Strobe
  - Significantly improved WiFi data download speeds

- Communications Section:
  - Allows for various options & customization
  - Houses the Payload & Comms processors, ascent weight, universal bulkhead adaptors, hard drives (16 – 50+ TB)
  - Provisions made for Cyber and Scuttle features
  - 2 Universal Bulkhead Adaptors allows for customer tailored options
  - 2 optional ‘plug and play’ environmental sensors



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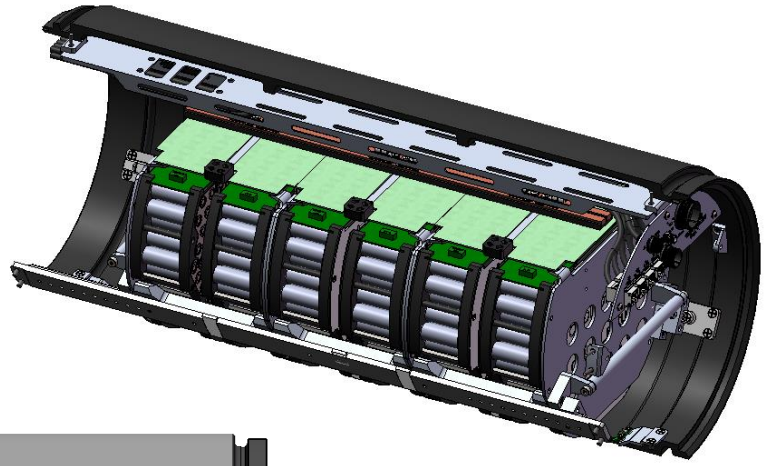
Energy



- Dedicated Energy Module
  - 9.7kWh, 48VDC (common battery cell to all models)
- Additional modules can be added to increase mission endurance and/or range, up to maximum of 3
- All energy modules are swappable with each other
- Charge and Discharge through the vehicle connector or directly to the energy section
  - Charge times 8-12 hours dependent on configuration. *Actual charge times will vary*

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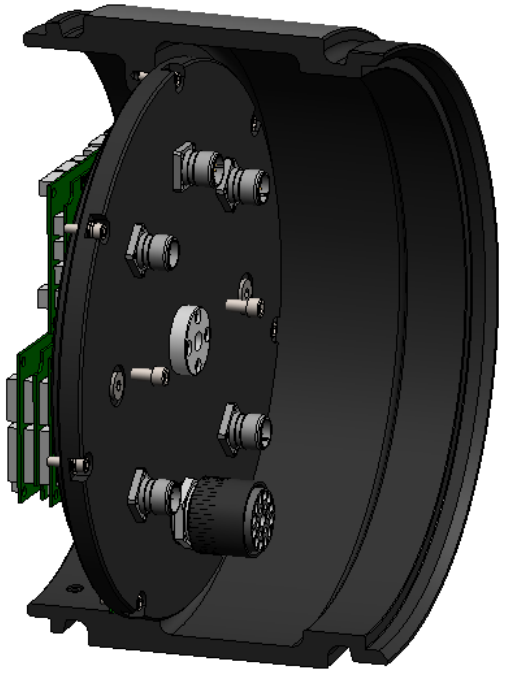
Universal Forward End Cap



- 2-piece modular hull design
  - Hull and Face Plate are two separate pieces
  - Facilitates custom modifications if needed
- Two payload connections available, each capable of 325 watts and Ethernet connections to the REMUS network
  - Additional connections could be available for custom needs

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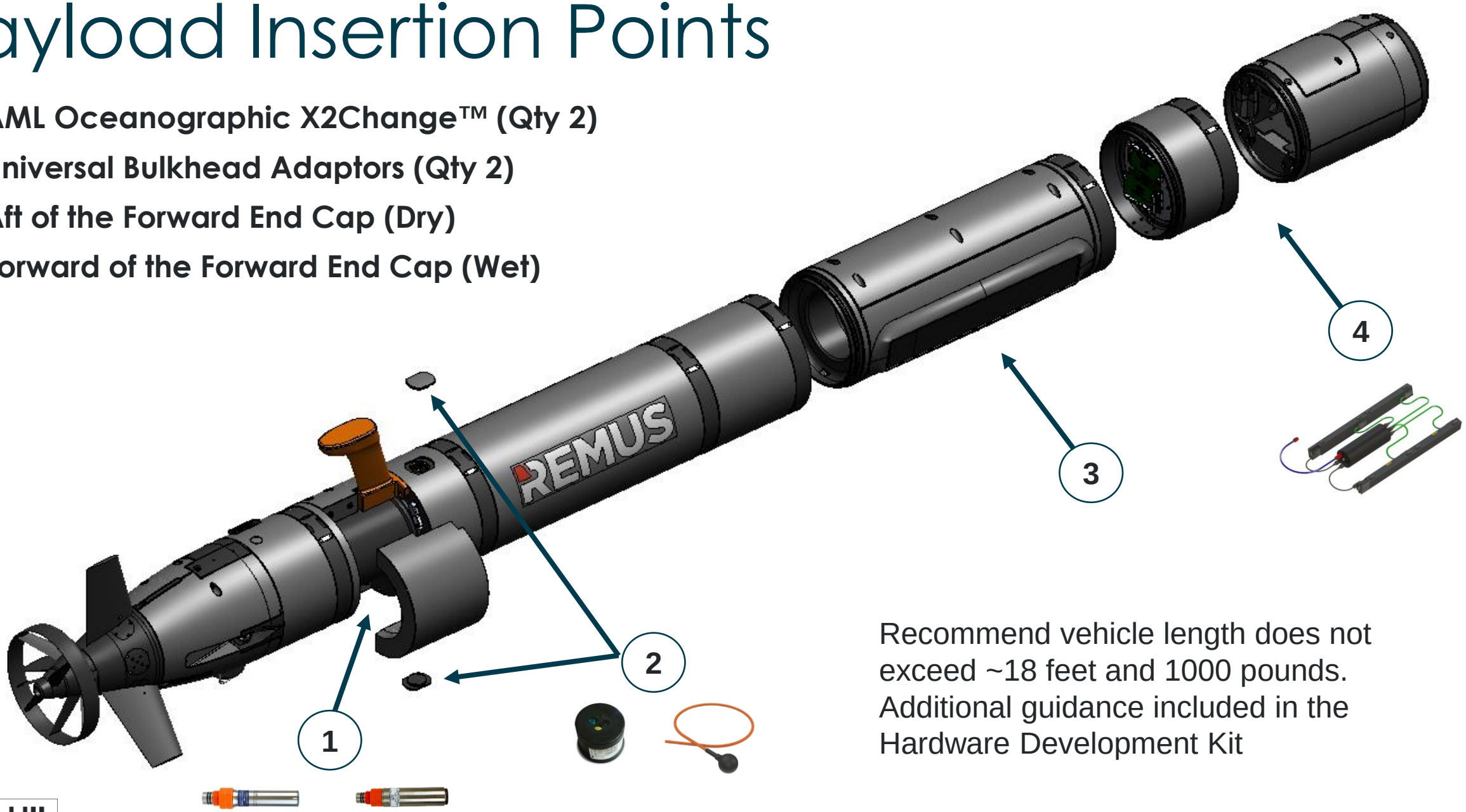
Payload Insertion Points

1. **AML Oceanographic X2Change™ (Qty 2)**
2. **Universal Bulkhead Adaptors (Qty 2)**
3. **Aft of the Forward End Cap (Dry)**
4. **Forward of the Forward End Cap (Wet)**



Recommend vehicle length does not exceed ~18 feet and 1000 pounds. Additional guidance included in the Hardware Development Kit

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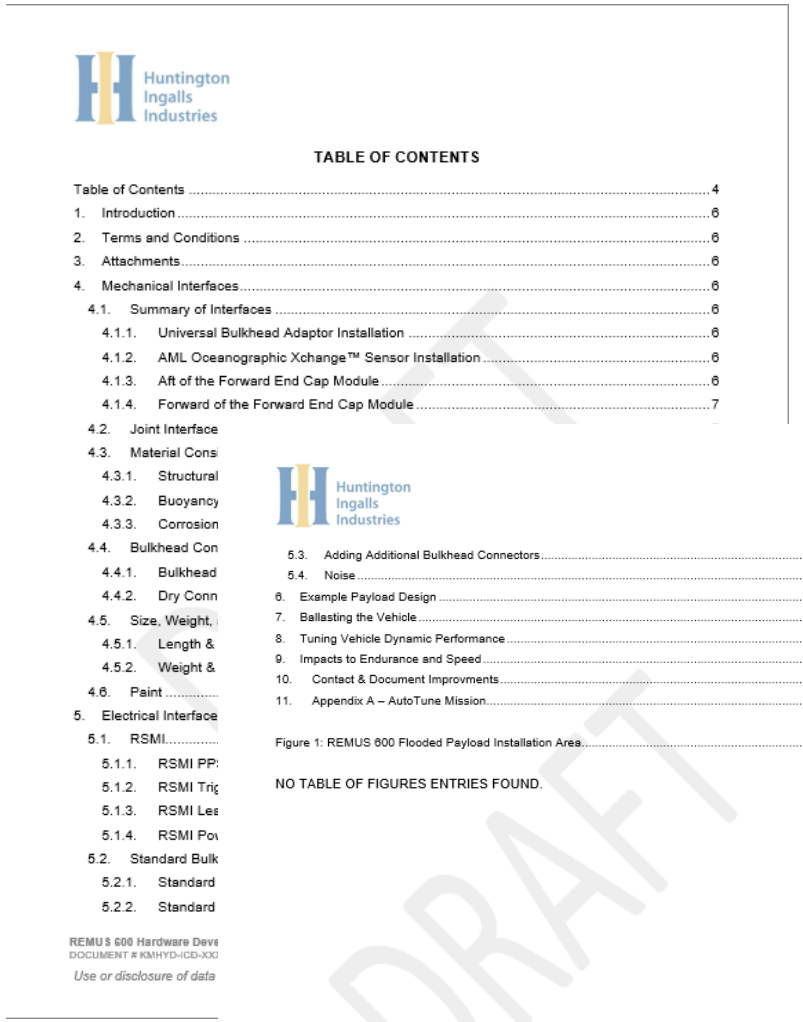
Payload Development Kits

- Hardware and Software Development Kits are available to support seamless integration of custom payloads
- The kits provide the information necessary to allow customers to integrate new hardware payloads and custom software packages
  - Will identify vehicle features, system interfaces, and documentation
  - Allows for varying levels of HII involvement
- Hardware packages will be available to facilitate ‘plug and play’ hardware integration
  - Examples include dry and wet payload frame kits, connector and cabling kits, syntactic foam, etc.



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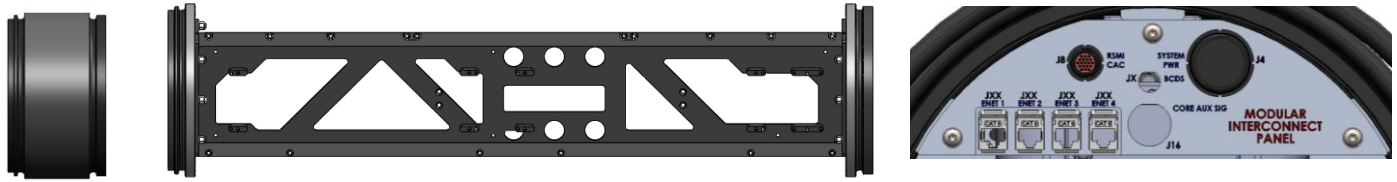

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Remus 300 & 620 Modular Payloads

SAS Payload Module For R300

Trials carried out with R100 pictured

- Compared to conventional sidescan sonar systems, SAS significantly improves the image resolution allowing for automatic detection and classification of small objects on the seafloor.

- SAS image resolutions are MCM GRADE (3cm x 3cm) and provide over 10x the area coverage rates of conventional sidescan sonar at equal resolutions with Swath ranges up to 250m.

- A REMUS 300 modular SAS payload allows insertion onto vehicle when a greater level of detail or area coverage is require for the mission

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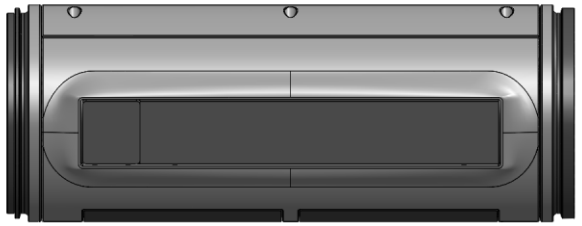
Synthetic Aperture Sonar (SAS)620 Payloads

Lithium-ion Battery Options	**(1X Battery) 9.65 kWh**	**(2X Battery) 19.30 kWh**	**(3X Battery) 28.95 kWh**
MINSAS 60 (Dry Payload) *Kraken Aquapix MINSAS 60 Interferometric Synthetic Aperture Sonar with bathymetry; Constant resolution of 3cm x 3cm* processed post-sortie (optionally real-time); Swath up to 236m*			
Length	3.8m (155 in.)	4.6m (185 in.)	5.4m (215 in.)
Weight	267kg (590 lb.)	335.2kg (739 lb.)	403kg (889 lb.)
*Estimated Endurance***	30 hours	55 hours	78 hours
*Maximum Range***	145km (78nm)	270km (146nm)	380km (205nm)

Lithium-ion Battery Options	**(1X Battery) 9.65 kWh**	**(2X Battery) 19.30 kWh**	**(3X Battery) 28.95 kWh**
MINSAS 120 (Wet Payoad) *Kraken Aquapix MINSAS 120 Interferometric Synthetic Aperture Sonar with bathymetry; Constant resolution of 3cm x 3cm* processed post-sortie (optionally real-time); Swath up to 440m*			
Length	4.3m (170 in.)	5.2m (205 in.)	N/A
Weight	283.5kg (625 lb.)	351.1kg (774 lb.)	N/A
*Estimated Endurance***	26 hours	50 hours	N/A
*Maximum Range***	130km (70nm)	245km (132nm)	N/A

MINSAS 60 (dry payload)



236 meters swath with bathymetry
3 cm x 3 cm resolution to full range

MINSAS 120 (wet payload)

440 meters swath with bathymetry
3 cm x 3 cm resolution to full range

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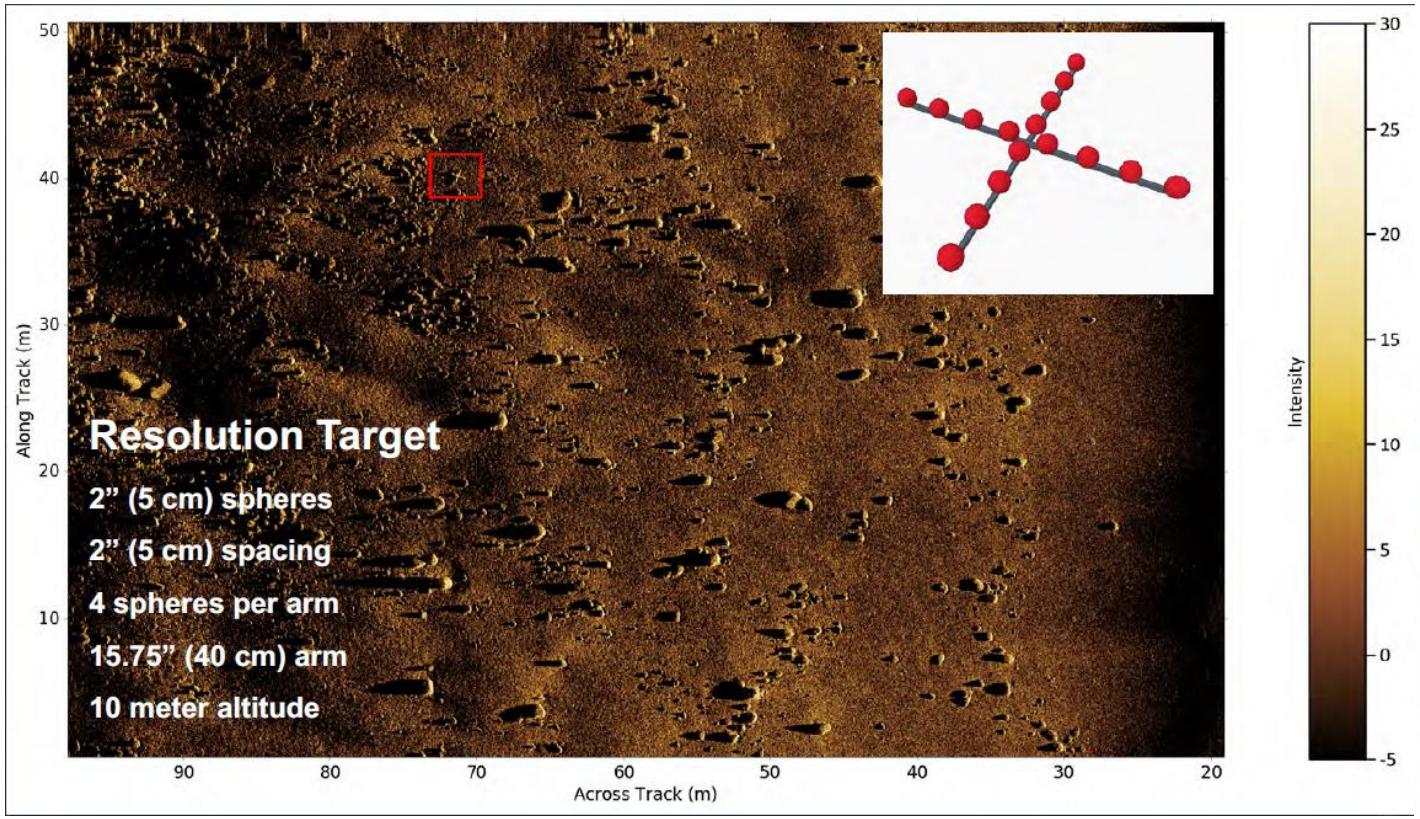
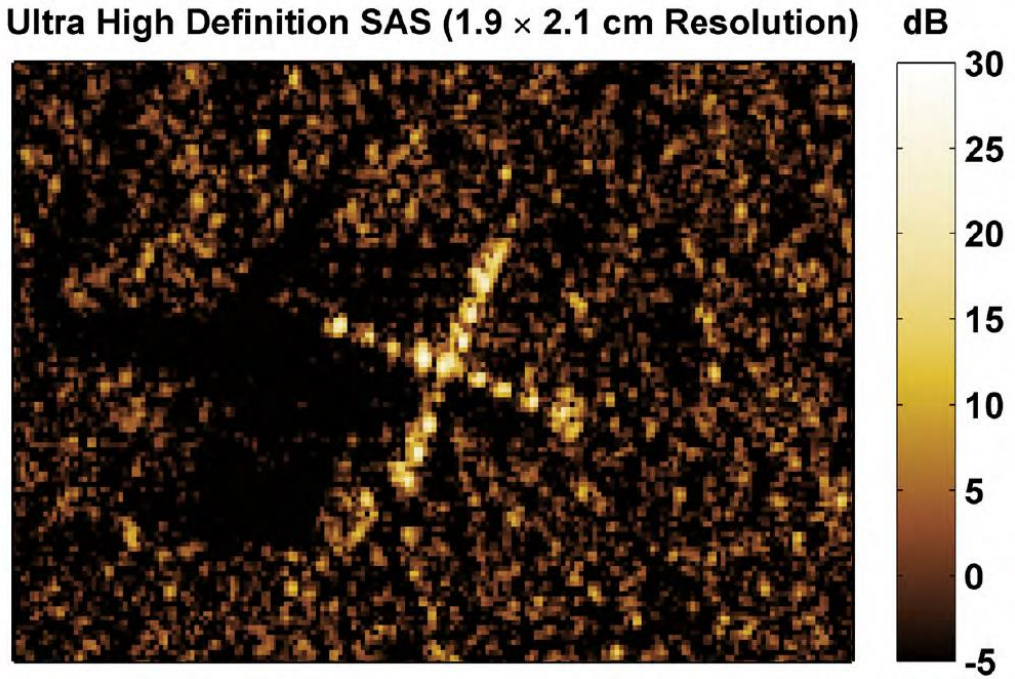
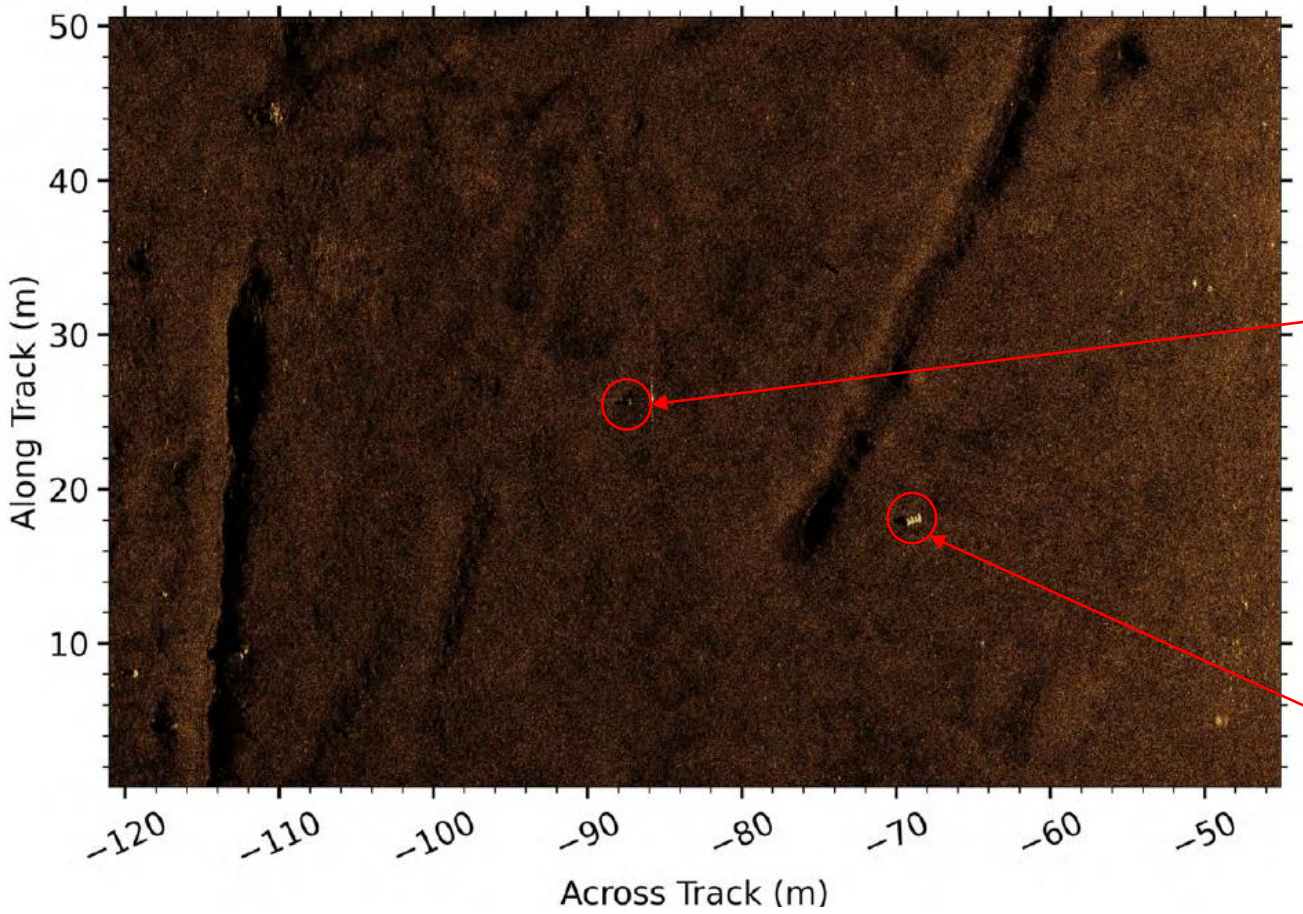
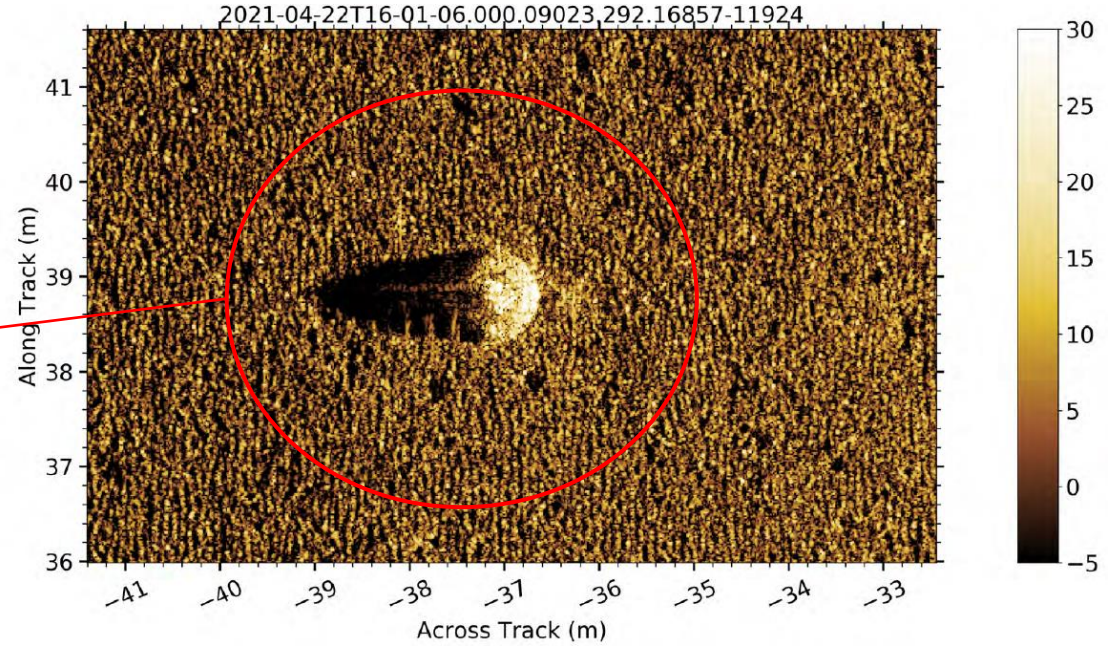
KRAKEN MINSAS MLO Images

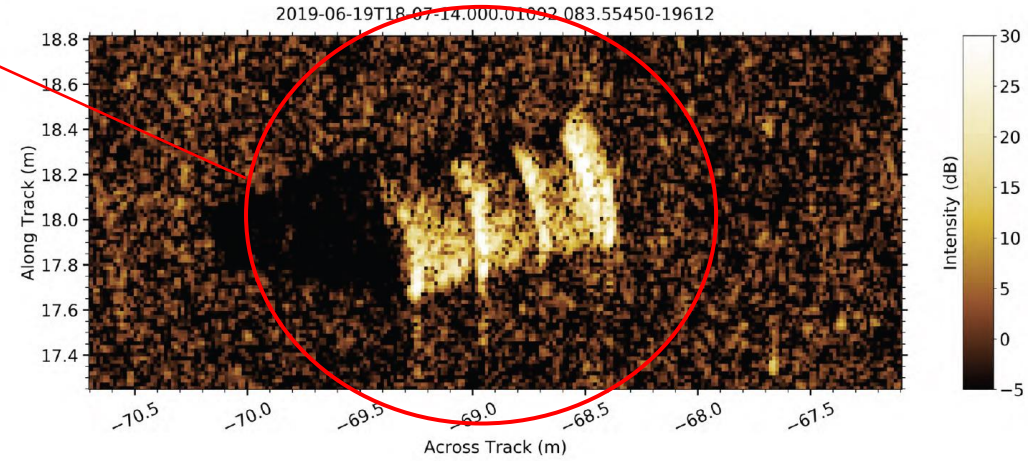




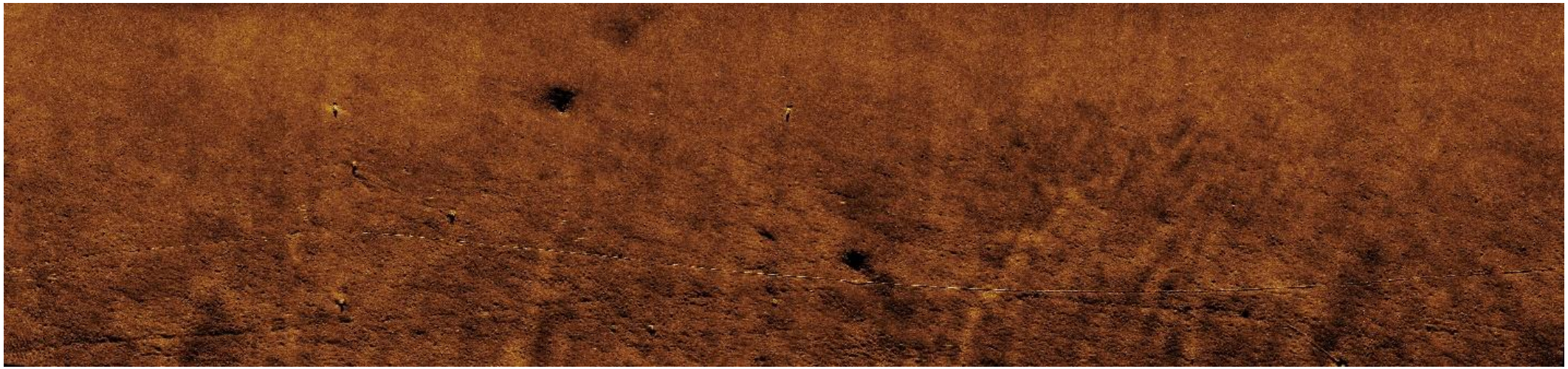
KRAKEN MINSAS MLO Images (2)





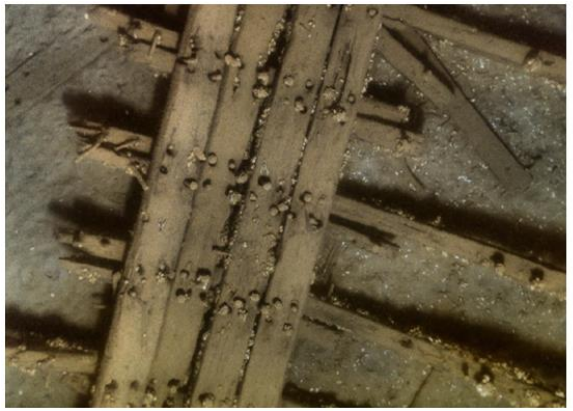


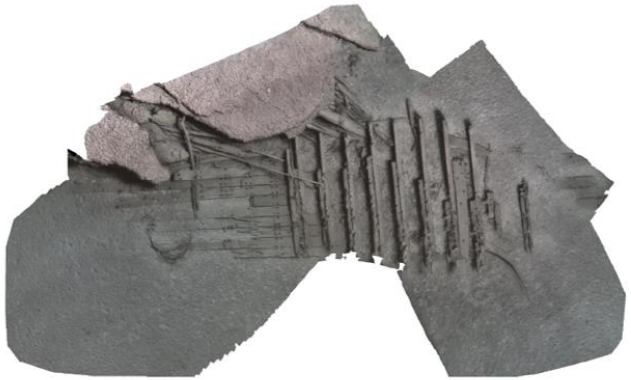
Kraken MINSAS 60 imaging 10cm comms cable (3cm x 3cm resolution)

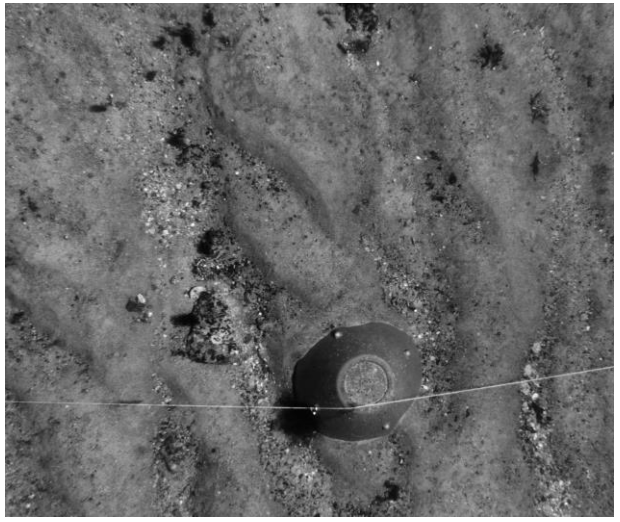


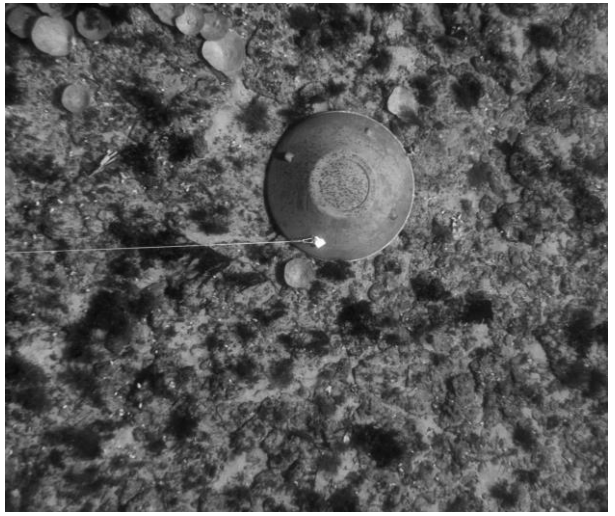
VOYIS 4k Photogrammetric Camera for Remus 300 and 620

- 4K “true-color” or monochrome digital stills camera
- Highly efficient, hydrodynamic lightbar (200,000 Lumen)
- Fully integrated image enhancement, with onboard data processing & storage
- Georeferenced stamped images for seamless photomosaicing and photogrammetry
- Add or retrofit the modular payload on the Remus 300 and 620



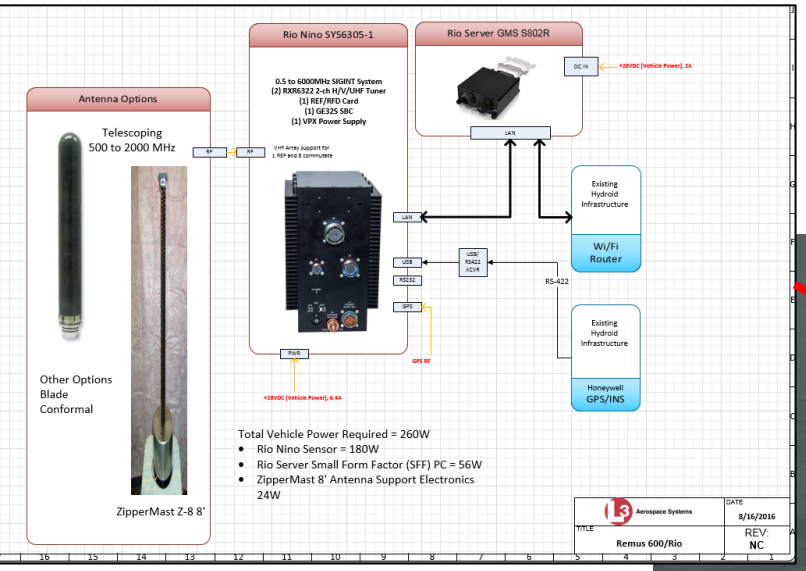




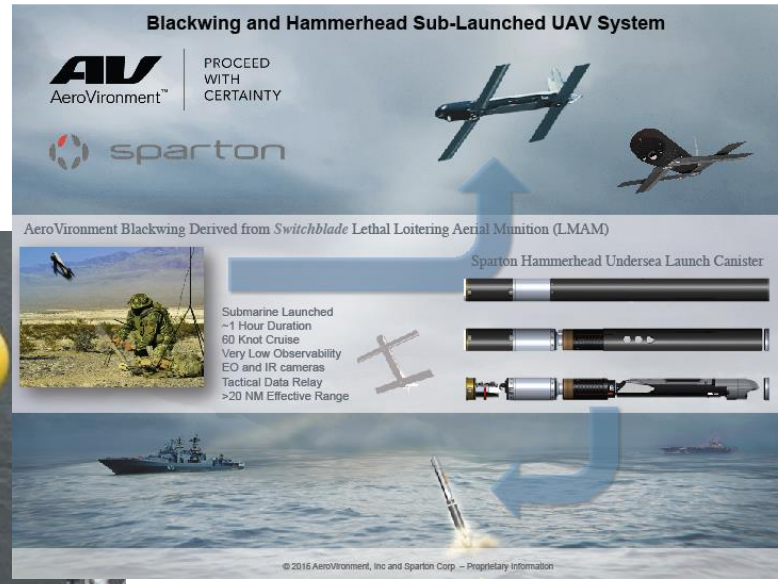


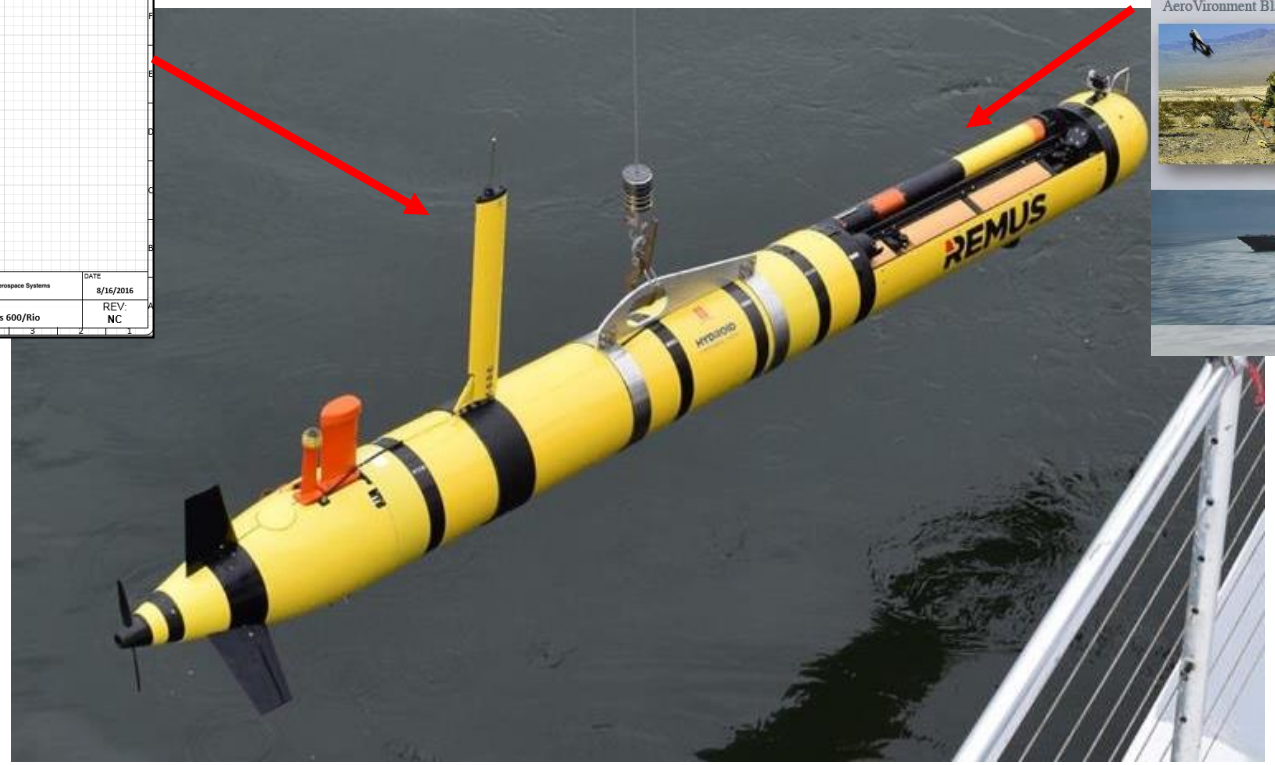
Example non-MCM payload: Above water ISR Mission application

SIGINT Payload from existing Programs of Record



Sparton and Aero environment UAV Payload





Successfully demonstrated during ANTX 2017 at Naval Undersea Warfare Center, Newport RI

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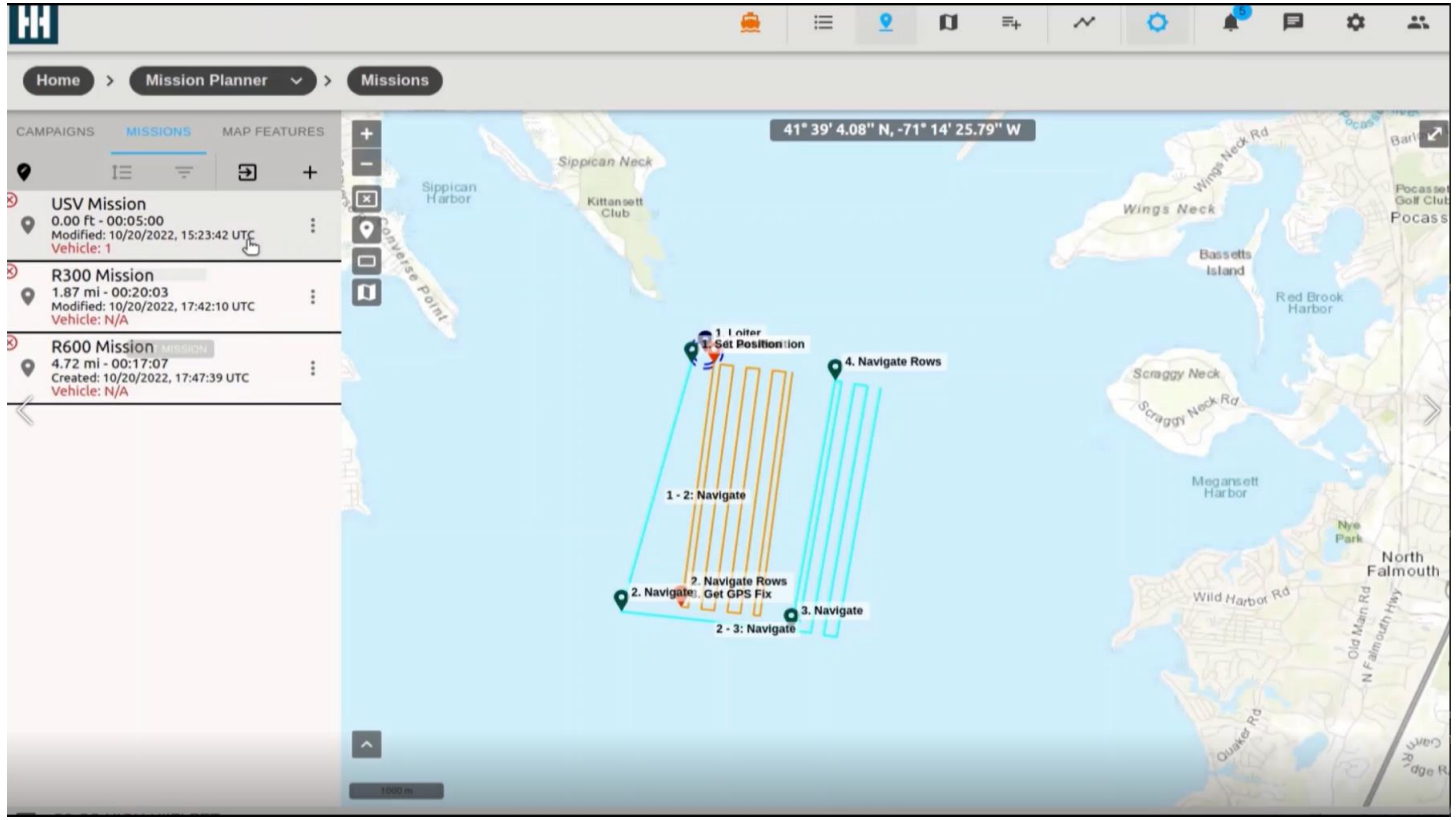
Remus New Common Graphical User Interface (GUI)

Odyssey Mission – Graphic User Interface



ODYSSEY

HII Advanced Autonomy Solutions

- Web-based Graphic User Interface
  - Classic REMUS VIP still availible
- Mission Planning, Monitoring, and Execution
- Post mission analysis tools
- Capable of simultaneous controlling multiple vehicles in different domains(USVs, UUVs)
- DDS based interfaces

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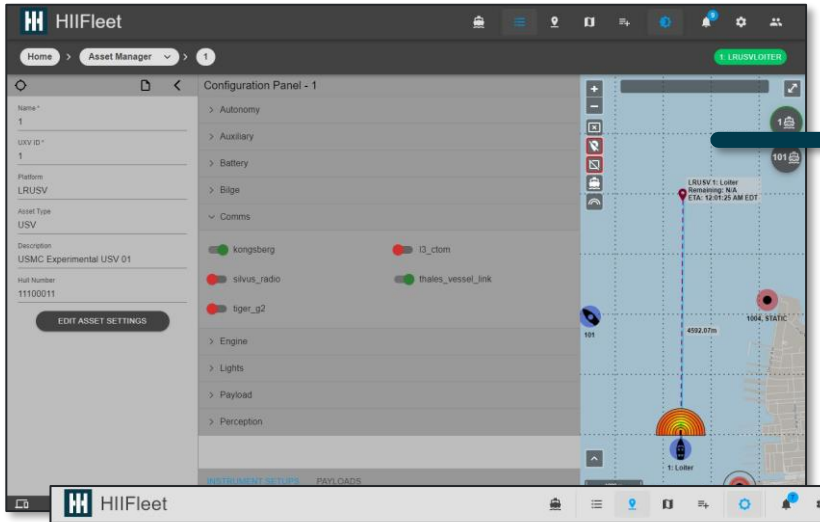
Odyssey Mission – New GUI in 2023

An all-in-one UxV management suite in the form of an intuitive web-based user interface

Manage | Plan | Monitor | Analyze



Asset Manager

Manage payloads, sensors, configurations, and more

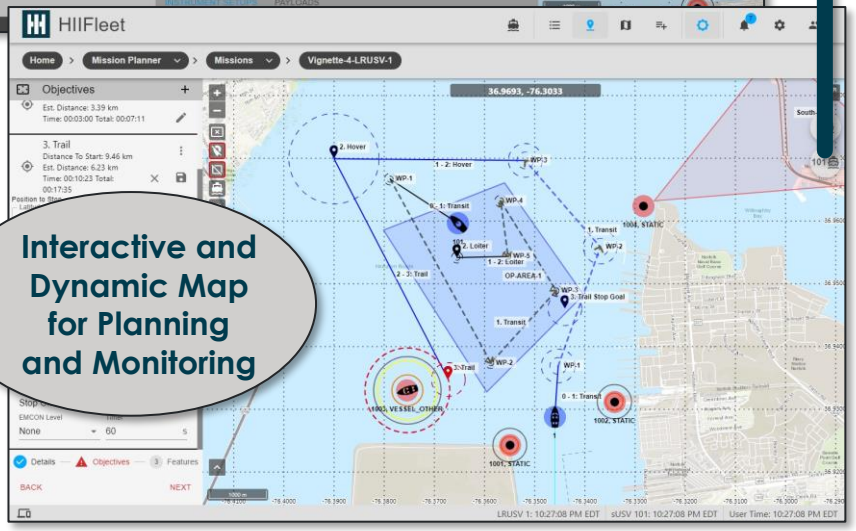
User Management, Communication Management, and More

User Defined Settings

Customized look and feel with access to offline maps and nautical charts

Mission Planner

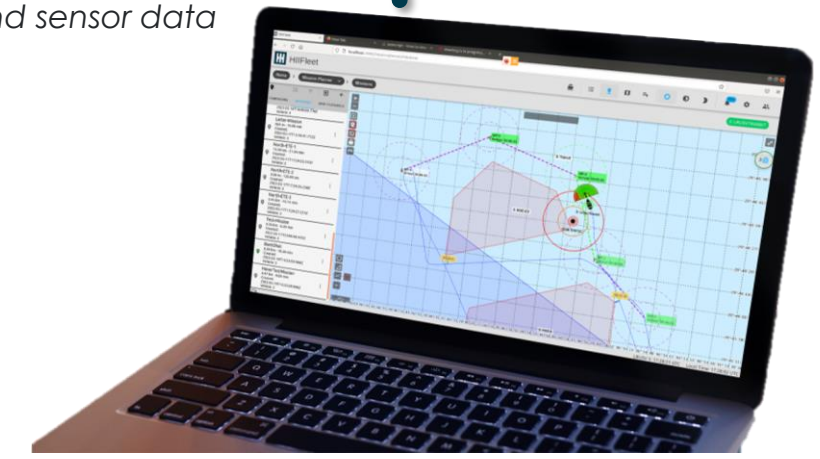
Plan, save, and reuse custom autonomous missions and behaviors with seamless map integration



Interactive and Dynamic Map for Planning and Monitoring

Mission Monitor

Real-time mission execution, health status, notifications, weather and sensor data



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Utilisation of mission modules with uncrewed platforms

- Part of a network of systems
- USV and UUVs working together
- Flexible CONOPS

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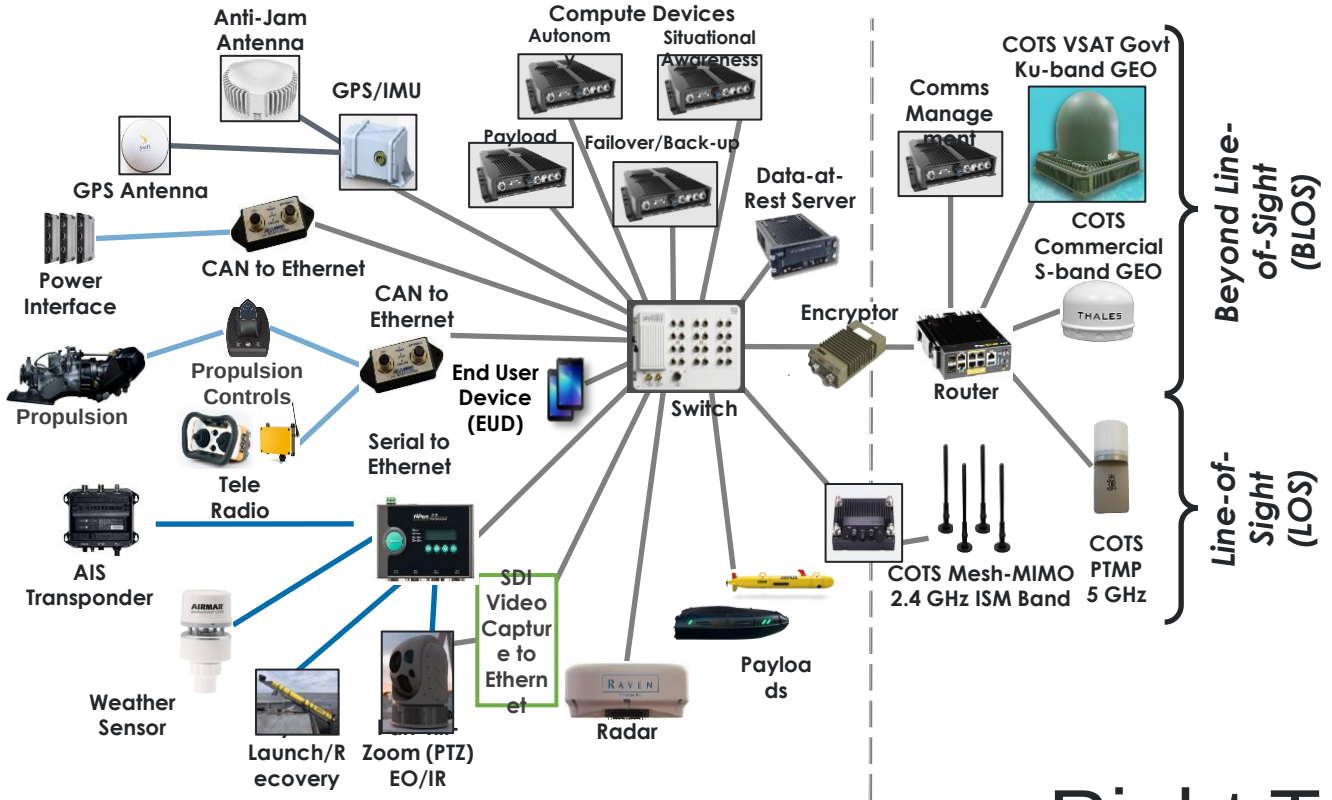
ODYSSEY
HII Advanced Autonomy Solutions



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= Right Tool for the Job

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Any Questions ?

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