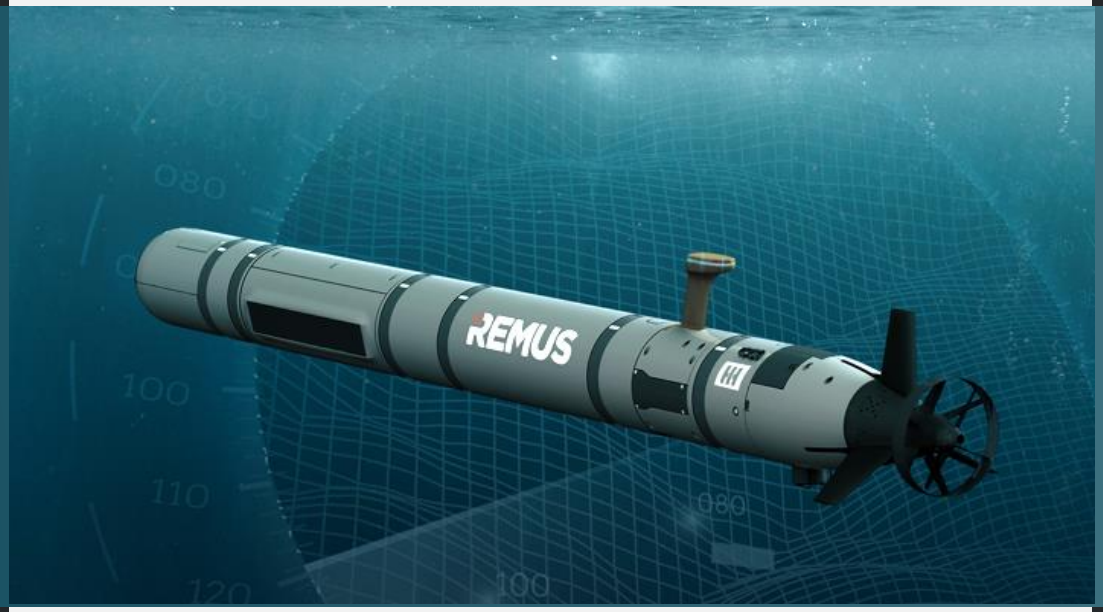
HII Unmanned Systems
UUV Interoperability and Cooperation

Achieving true inter-navy asset sharing and mission delivery

Unmanned Systems

World-leading autonomy and multi-domain autonomous systems manufacturer for defense, research and commercial applications.



Capabilities

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

Notable Programs

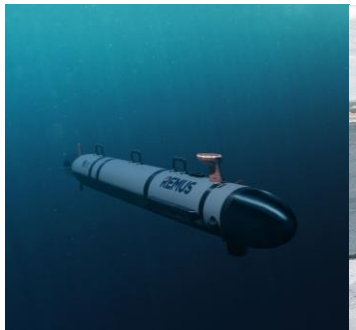
- 22 years of supply of REMUS UUVs (REMUS 100, REMUS 300, REMUS 600, REMUS 6000)
- U.S. Navy MK18 UUV and LBS-AUV
- USN Lionfish small UUV replacement PoR
- Royal Navy Hunt+ upgrade for the UUV requirement
- Mainstay of many of the worlds Navies' UUV needs

From Autonomy – Interoperable Autonomy

- True autonomous systems have now been around for more than a generation: REMUS 1998
- "Trusted Autonomy" is more than a buzz word today: UAVs, USVs, UUVs, cars, trains, machines across defense, oil & gas, manufacture, mining, construction, travel and other industries all utilize and have begun to rely on autonomous capabilities
- Application of AI & machine learning is now widespread

Can my autonomy play with your autonomy?

- Different vehicles
- Different payloads
- Different mission software
- Different sensors
- Different "levels of autonomy"



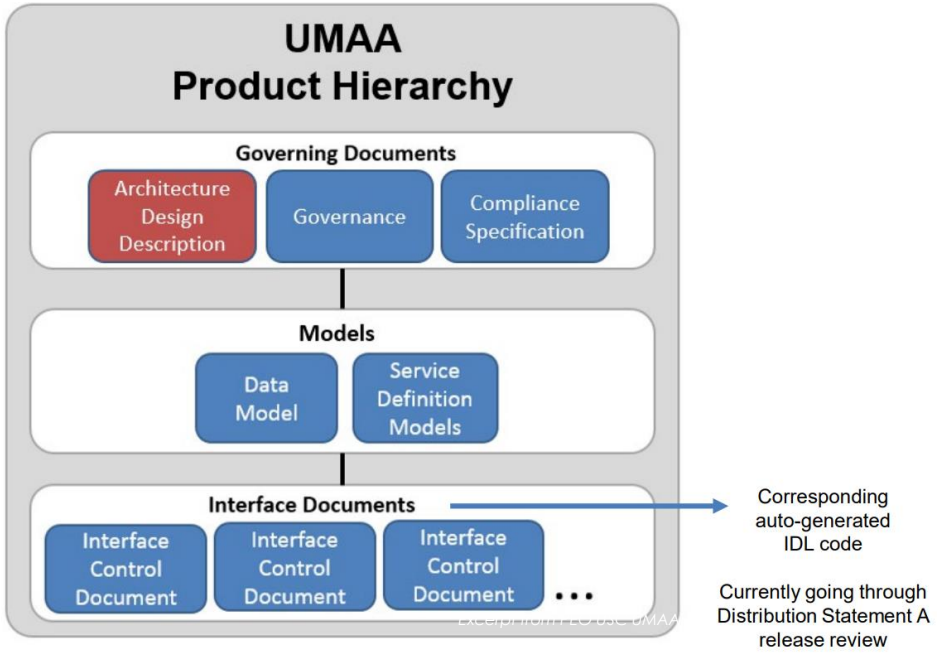
The Use of Open Architecture UUVs & Mission Management Systems

- Open architecture allows easier integration of third-party payloads and software
- Allows for a common systems with the right tool for the right mission
- Common modularity across platforms
- 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

Key Essential Characteristics

What do interoperable systems look like?

- Common governance
- Common design architecture
- Open audit and assessment of systems for compliance to agreed standards
- Cross domain (surface & underwater (& air)) operation



Easier said than done?

Need to avoid “vendor lock”

- Avoid reliance on single manufacturer proprietary autonomy sw / mission management systems
- Need ability for autonomous platforms to allow both “front” and “back seat” driving by different autonomy softwares to achieve optimum mission goals using shared systems
- Requires portability of capabilities across platforms
  - Requires willingness by manufacturers to modify existing hardware & software
  - Puts risk on manufacturers IP and incurs costs
- Requires lead by governments using international collaboration for funded development of autonomy structures: MAPLE is a good example

No Vendor Lock In

Cross Allied Cooperation within UUV Missions

REMUS 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

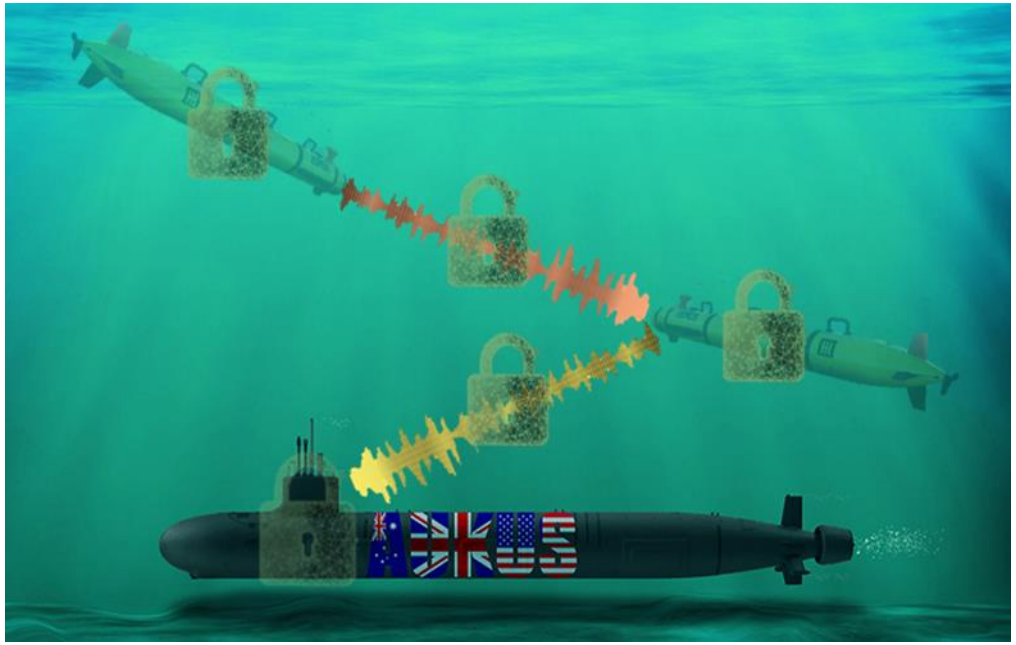
Collaborative UUV missions – now a real fact

- The US Navy (USN), Royal Navy (RN) and Royal Netherlands Navy (RNLN) successfully executed a multi-national REMUS / SeeByte Neptune autonomy mission to conduct in-stride SCM and dynamic RI on real-time ATR detected targets as a collaborative squad at REPMUS 23
- This is the first time "operational" units from multiple nations have executed a collaborative in-stride Search-Classify-Map (SCM) and dynamic Reacquisition-Identification (RI) autonomy mission.
- Uncrewed maritime systems used:
  US : Neptune enabled MK18 MOD2
  UK : Neptune enabled REMUS 100 (Marine Sonics SSS)
  Netherlands : Neptune enabled REMUS 100 (Kraken SAS)

Common Security for Common Platforms

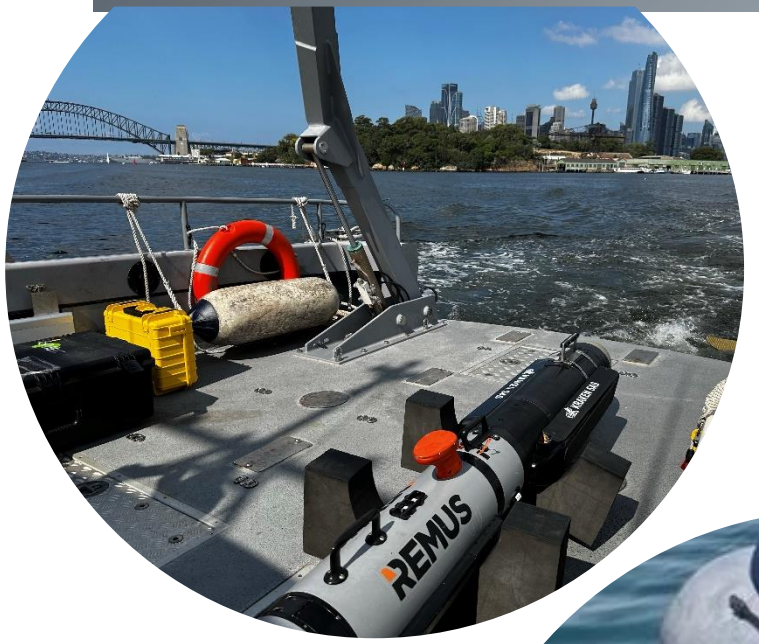
- The use of multiple autonomous assets owned and operated by multiple partnered forces gives rise to the need for common security standards and protocols to protect mission & sensor data from falling into enemy hands or allowing enemy interdiction of autonomous assets on mission.
- All data stored on the asset (sensor data and vehicle mission data) needs encryption - DATA AT REST
- Likewise, any command and control data (RF, WIFI, Satellite & Acoustic) needs the ability to be encrypted – DATA IN TRANSIT
- Historically, partnered forces may have selected different encryption protocols and systems to provide this capability.

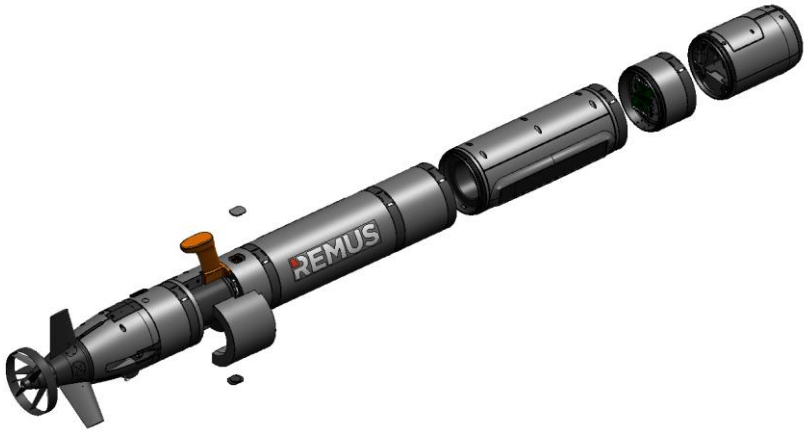
HII now provide the capability to provide REMUS to allied navies with common encryption systems.



In latest generation of all REMUS vehicles

- Now fully modular for batteries and payloads
- Open software and hardware architecture
- Cybersecurity
- Hardware and software developer kits





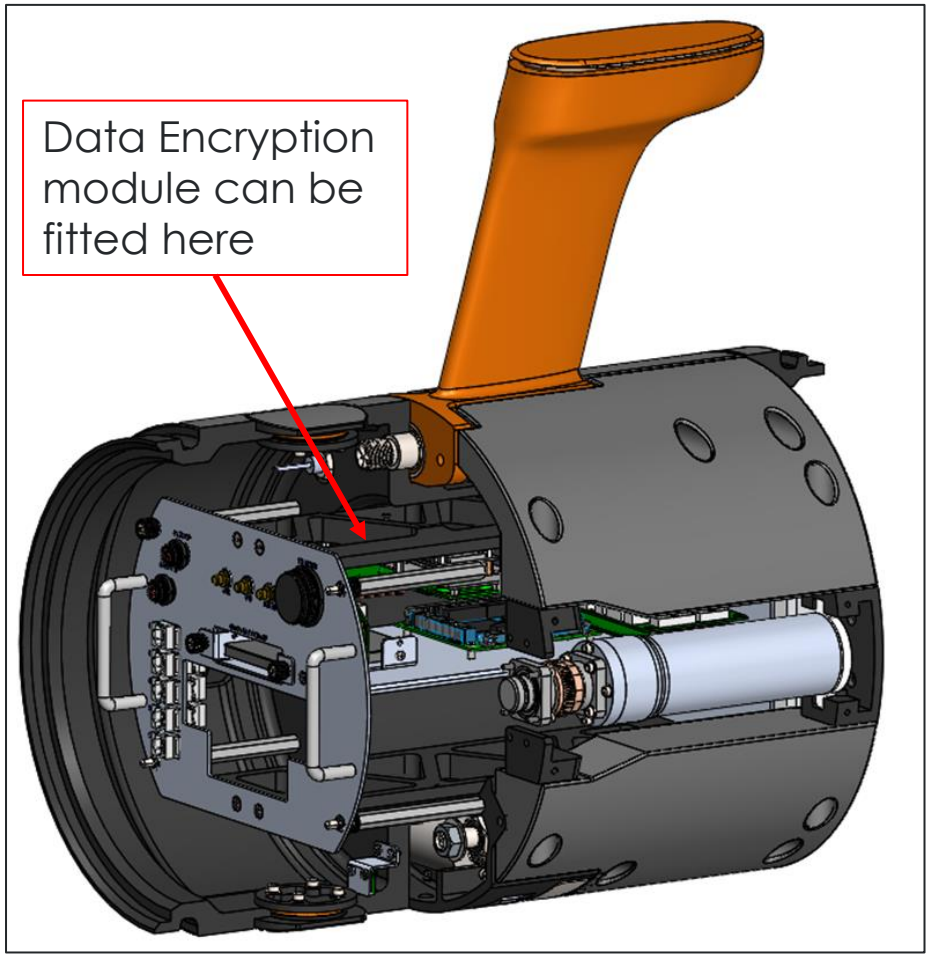
Cross platform / cross navy encryption of data

- HII REMUS vehicles can support full cyber compliance:

- Full encryption of data – “in-transit” & “at rest”
  - All C2 commands acoustic, RF etc are encrypted (“In-transit” data)
  - All vehicle mission data is encrypted
  - All acquired sensor data is encrypted (“at-rest” data)

- Encryption of data “at-rest” only

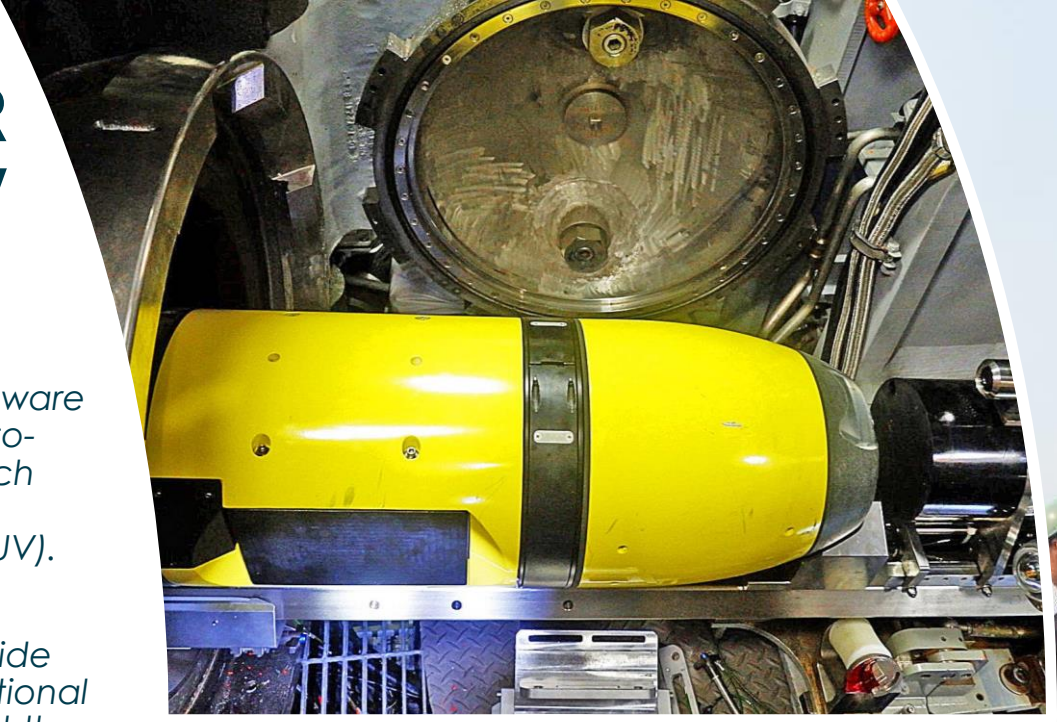
- **Subject to USN to Gov approval, partner nations can access this same encryption**

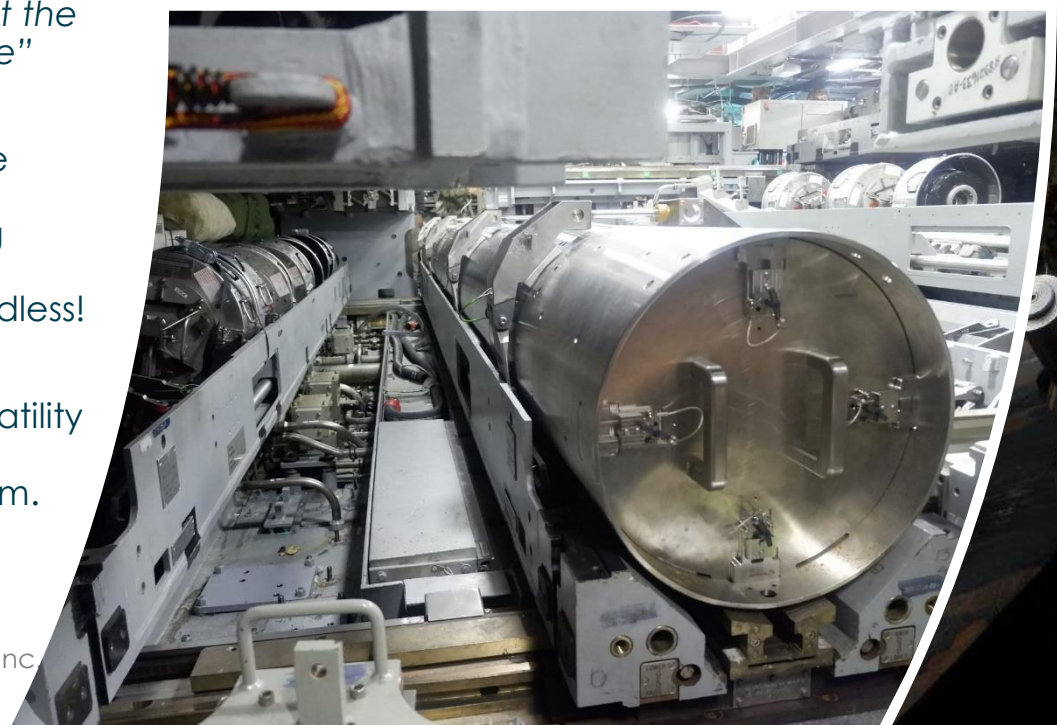


REMUS 620 – internal payload bay #2 for encryption module

Torpedo Tube L&R of REMUS 600 UUV

- *Dec 2023 the crew of the USS Delaware (SSN 791) completed the first end-to-end submarine torpedo tube launch and recovery of a REMUS medium unmanned underwater vehicle (UUV).*
- *"The Yellow Moray system will provide the U.S. submarine force with additional mission capability, enhancing what the U.S. Navy's submarines can provide"*
- Unaided, end to end torpedo tube launch and recovery is a critical enabling technology for achieving routine deployment of UUVs from submarines. The possibilities are endless!
- This success also highlights the versatility of the modular, open architecture HII REMUS UUV platform.





Odyssey™

Advanced Autonomy Solutions

Transform any vehicle into an intelligent robotic platform.

Delivered from a variety of vehicle, module and algorithm-level implementations across platforms, sensors, payloads and missions, Odyssey™ enables multi-vehicle collaborative autonomy, sensor fusion and advanced perception.

Advanced, intelligent autonomy solutions for platforms in any domain.

Odyssey Teams
Multi-vehicle, collaborative autonomy

Odyssey Vision
Perception and sensor fusion integration

Odyssey Health
Advanced autonomous health monitoring

Odyssey Mission
Intuitive command and control interface

Odyssey Commander
Enhanced mission manager for complex operations

Odyssey Bridge
Safe navigation on manned platforms

ODYSSEY

ADVANCED AUTONOMY SOLUTIONS

Applications for advanced behaviors and complex, collaborative, cross-domain operations

Odyssey Teams

Multi-vehicle, collaborative autonomy

- Shared situational awareness across platforms
- Simultaneous, multiple platform control
- Cross-domain collaboration
- Collaborative task allocation, route planning, decision-making
- Elastic self-healing to manage individual platform loss
- Swarm operations

Odyssey Vision

Perception and sensor fusion integration

- Tailored sensor suite
- Fused perception across variety of sensors and payloads
- Enhanced situational awareness, dynamic target detection, obstacle avoidance, and optimal navigation

Odyssey Health

Advanced autonomous health monitoring

- Summary view of platform health status
- Resource usage prioritization and autonomously redistributed tasks to maximize performance
- Component degradation predictions and preventive maintenance recommendations

Odyssey Mission

Intuitive command and control interface

- Advanced, intuitive user interface
- Sophisticated mission planning, monitoring, and post mission planning
- Simultaneous multi-vehicle control
- Cloud or Server based

Odyssey Commander

Enhanced mission manager for complex operations

- Mission, progress, and platform status monitoring
- Adaptive resource management
- Priority-based in-stride mission planning and adjustments
- Autonomous transmission of execution commands to other autonomy modules and platforms

Odyssey Bridge

Safe navigation on manned platforms

- Enhanced situational awareness and decision-making
- Improved human cognitive performance
- Seamlessly balanced efficient transits, hazard and collision avoidance, and time on target

Odyssey USV Software and Hardware

Odyssey USV Autonomy

Odyssey Vision
- Sensor interfaces and data processing
- Sensor Fusion
- Track Correlation

Odyssey Commander
- Autonomous Mission Management
- Mission execution and scheduling
- Single-vessel behaviors

Odyssey Teams
- Multi-vehicle collaborative autonomy and behaviors

Odyssey Health
- Health monitoring
- Fault detection & Mitigation
- Advanced diagnostics and prognostics

Odyssey Mission
- C2 Station
- Pre-Mission checkout & setup
- Mission rehearsal
- Mission planning & monitoring
- Post Mission Analysis

USV Vehicle Operations

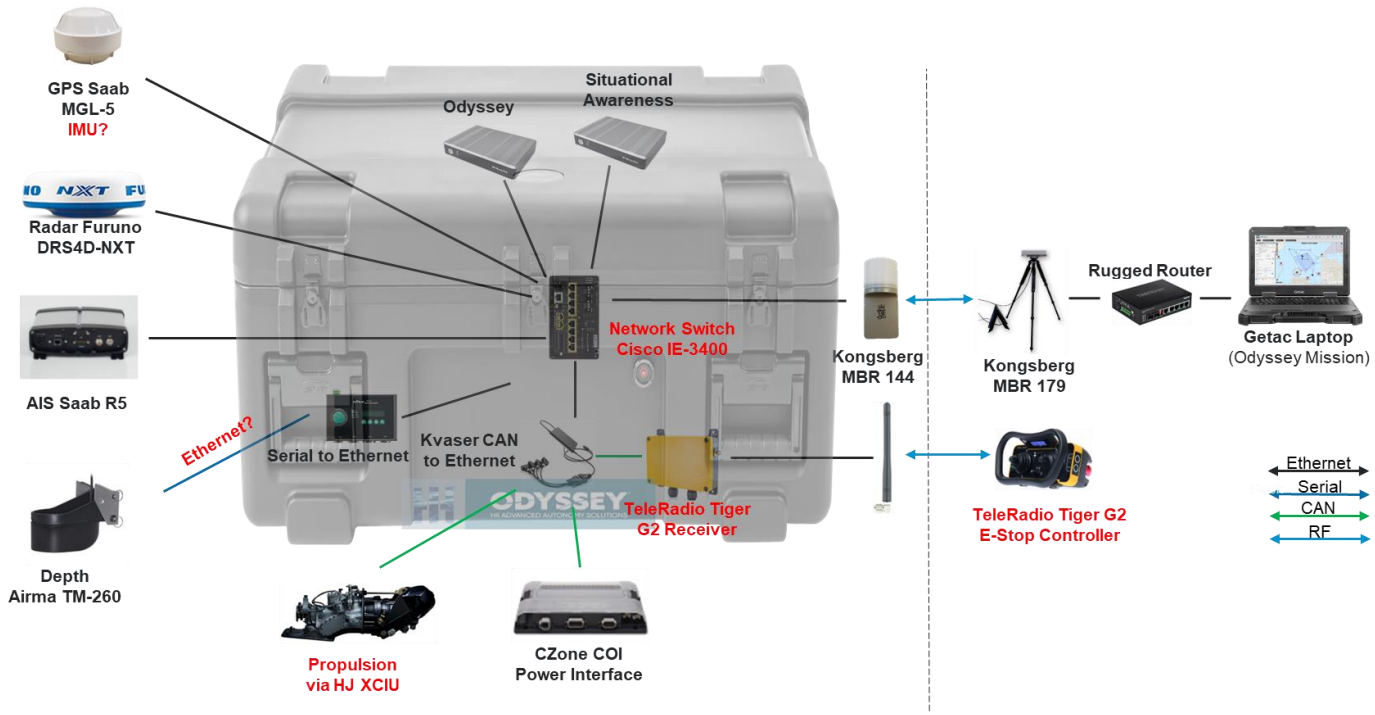
Interfaces for Engines, Auxiliaries, Power, Remote Control, E-Stop

USV Sensors and PNT

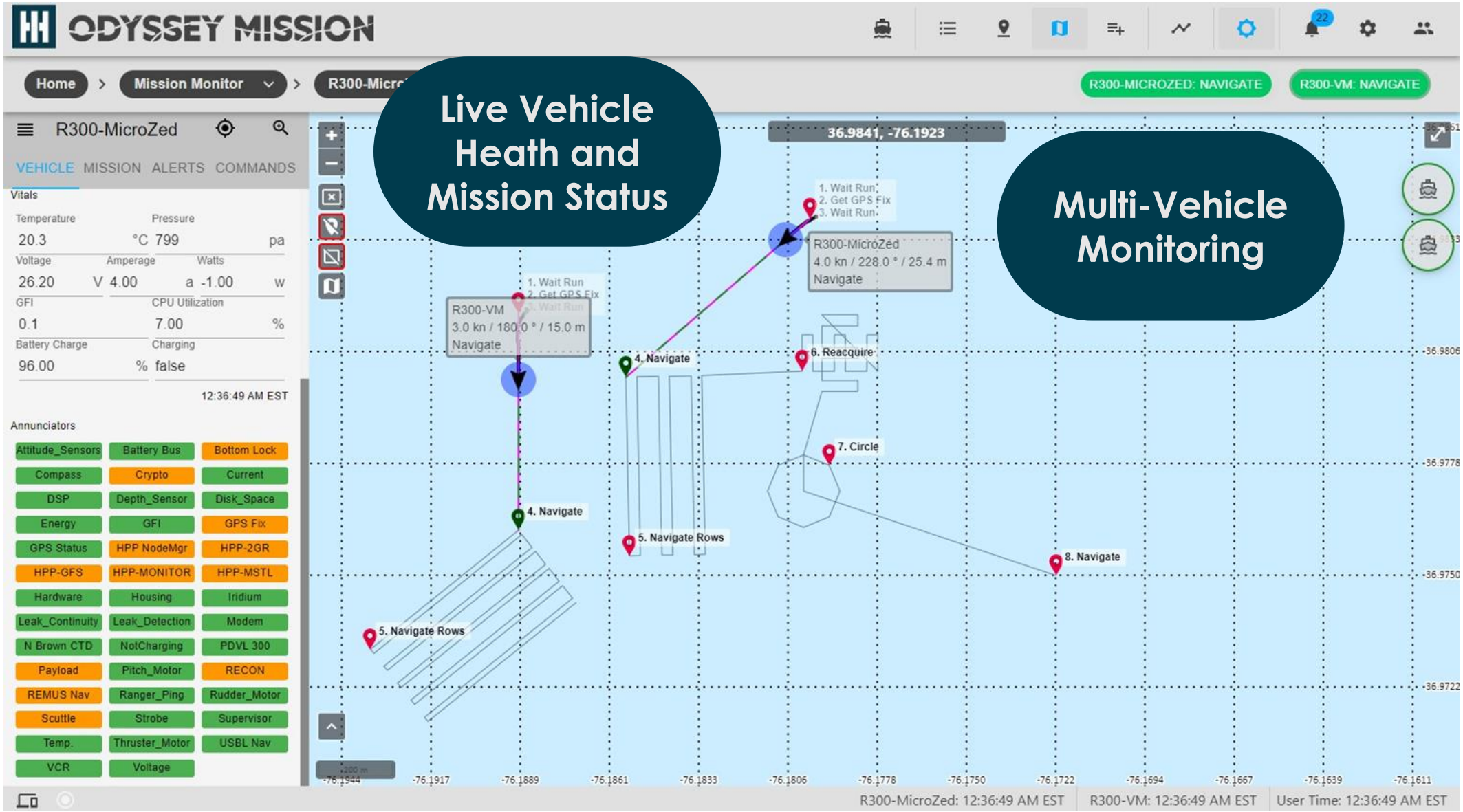
Interfaces for radar, AIS, PNT, weather, EO/IR

USV Payload

Interfaces for payloads which can also be linked to Odyssey Mission



Mission Monitor



Any Questions ?

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