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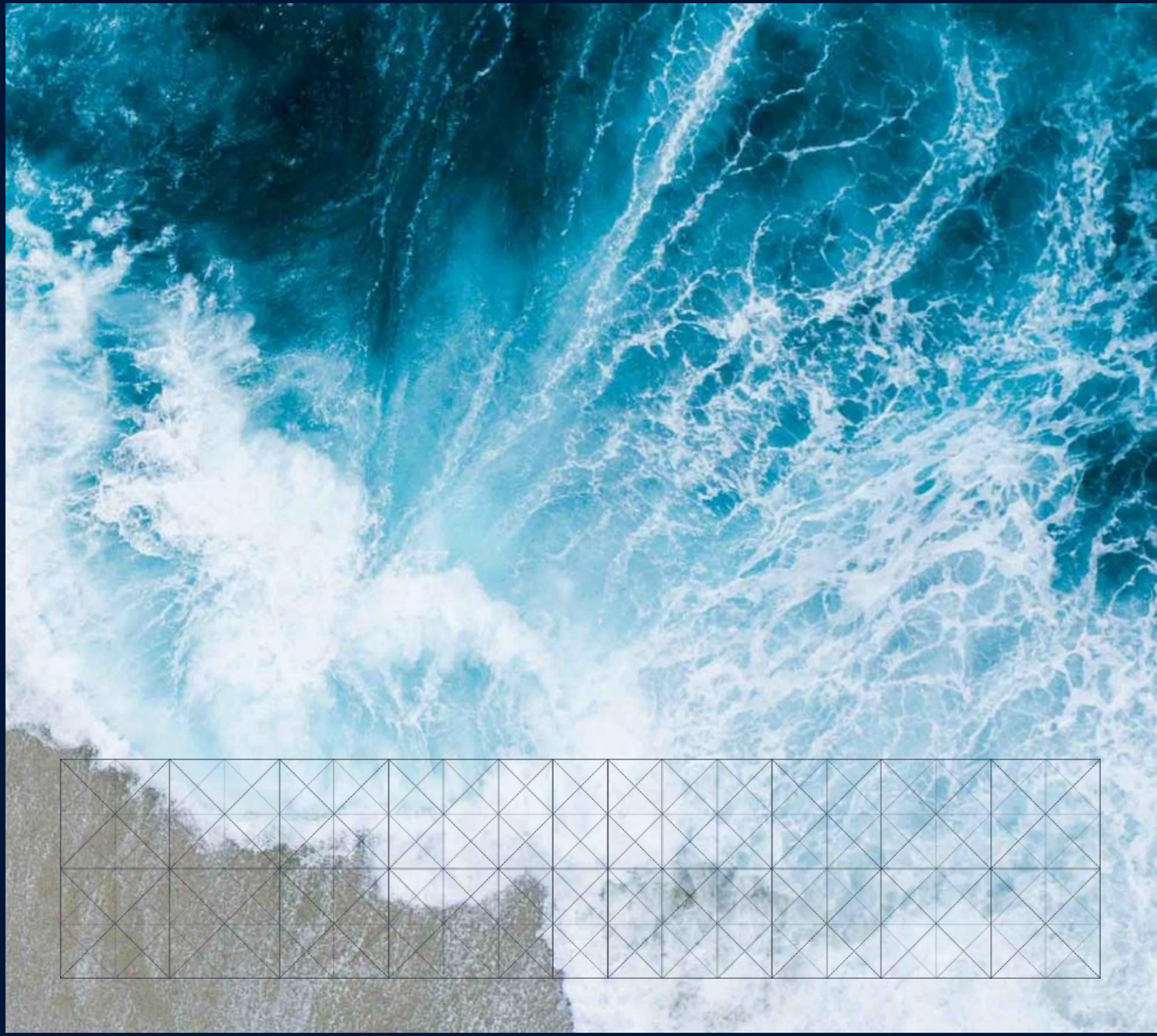
KONGSBERG DISCOVERY

CNI: Tools and CONOPS for Effective Inspection

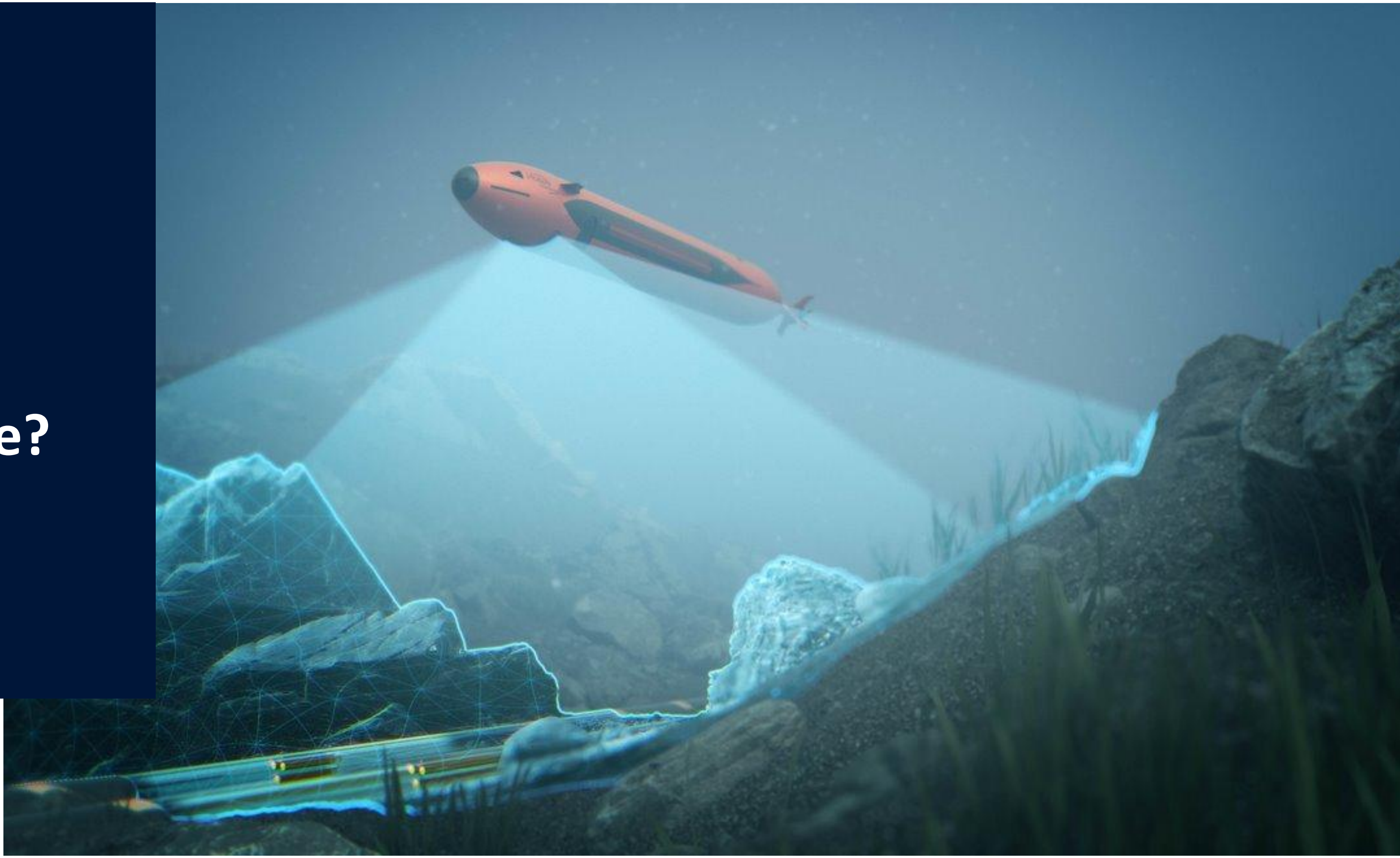
23/05/2023



Rich Patterson

Dir. of Sales for Uncrewed Platforms

Are we vulnerable?



Submarine Communications Cables

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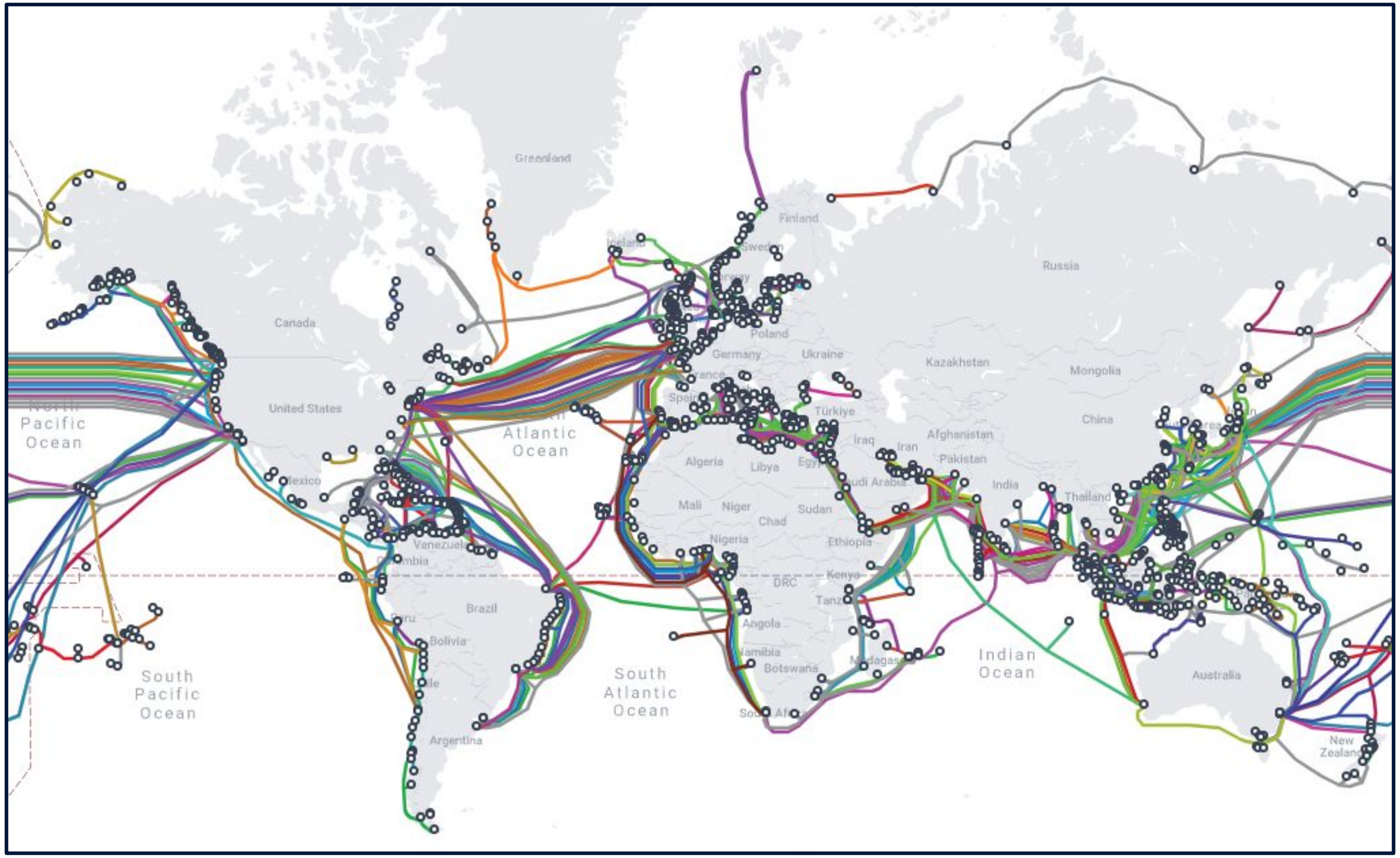

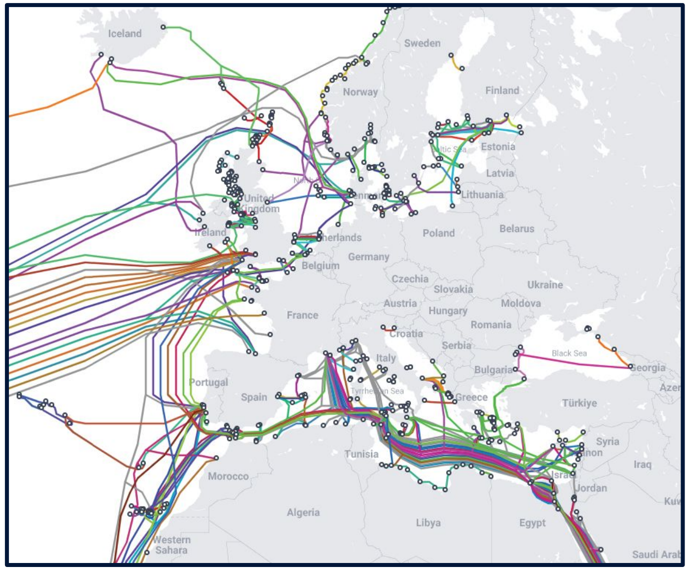

Source: TeleGeography, *Submarine Cable Map*, 2022, https://www.submarinecablemap.com/.

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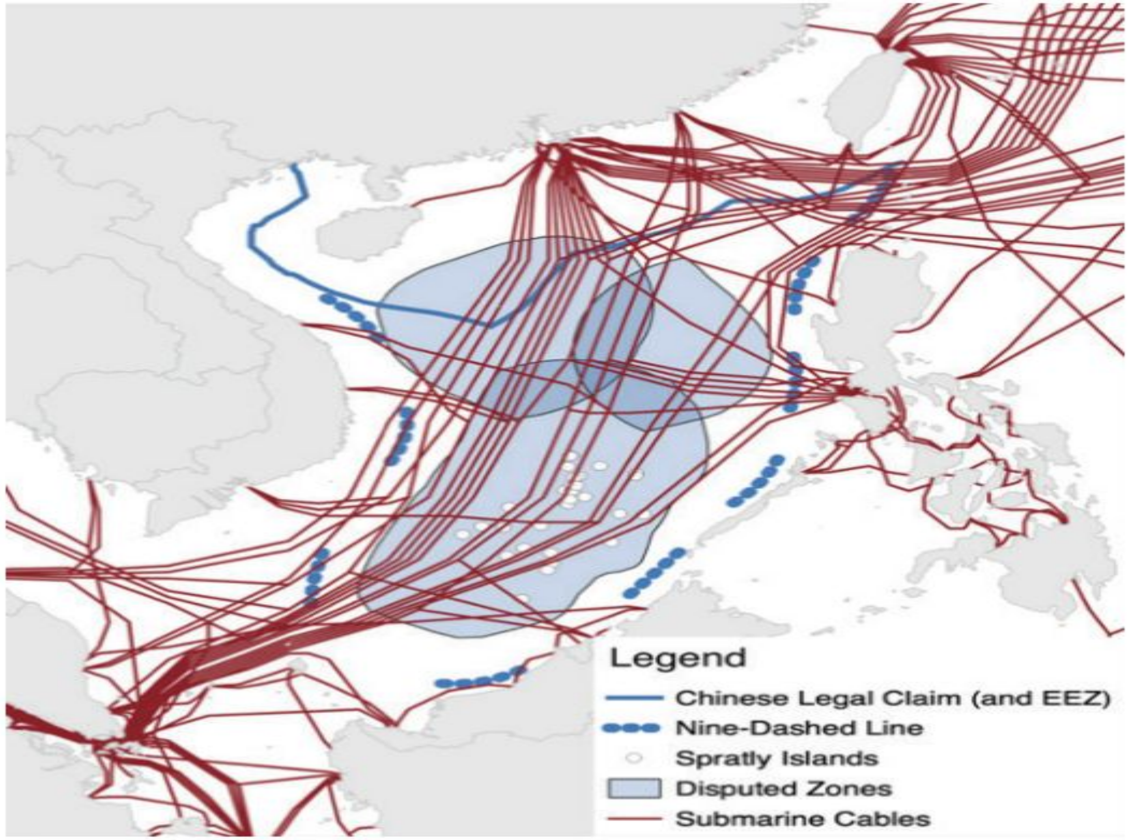
Submarine Communications Cables

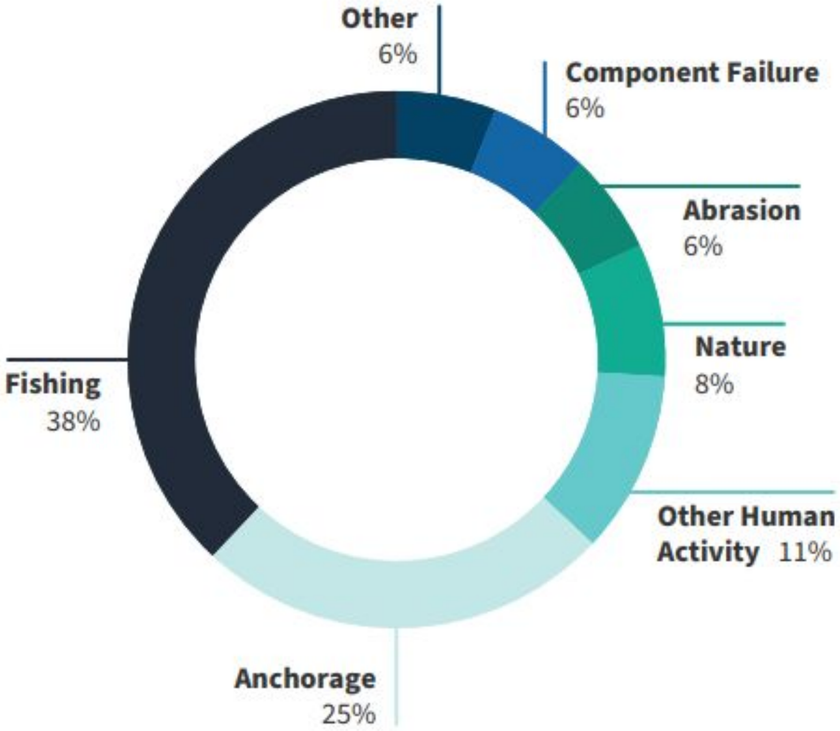
Contested Areas



Source: TeleGeography map adapted from Greg Poling, *The South China Sea in Focus: Clarifying the Limits of Maritime Dispute* (Washington, DC/Lanham, MD: CSIS/Rowman & Littlefield, 2013), https://www.csis.org/analysis/south-china-sea-focus. Reprinted with permission.

Submarine Communications Cables

Is there a threat?



Source: Alan Mauldin, "Cable Breakage: When and How Cables Go Down," TeleGeography, May 3, 2017, https://blog.telegeography.com/what-happens-when-submarine-cables-break.

- 1959: Soviet trawler damages 5 cables near Newfoundland
- 2006: Earthquake severs 6 of the 7 undersea cables connecting North America with Taiwan, China, Hong Kong, S. Korea and Singapore
- 2007: Vietnamese pirates steal optical amplifiers
- 2008: Three cables connecting Europe to ME and S. Asia were damaged off the coast of Egypt
- 2013: Divers intentionally cut SEA-ME-WE 4 cable
- 2022: Cable connecting mainland Norway to Svalbard is damaged in deep water, unknown cause

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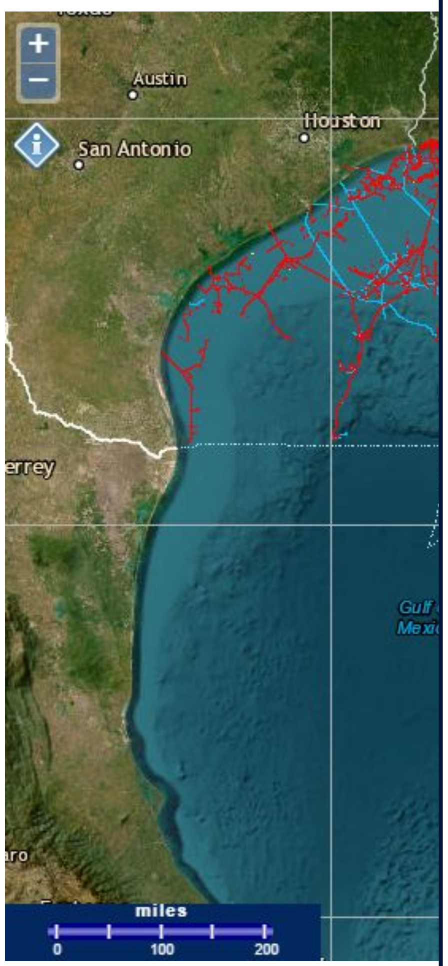
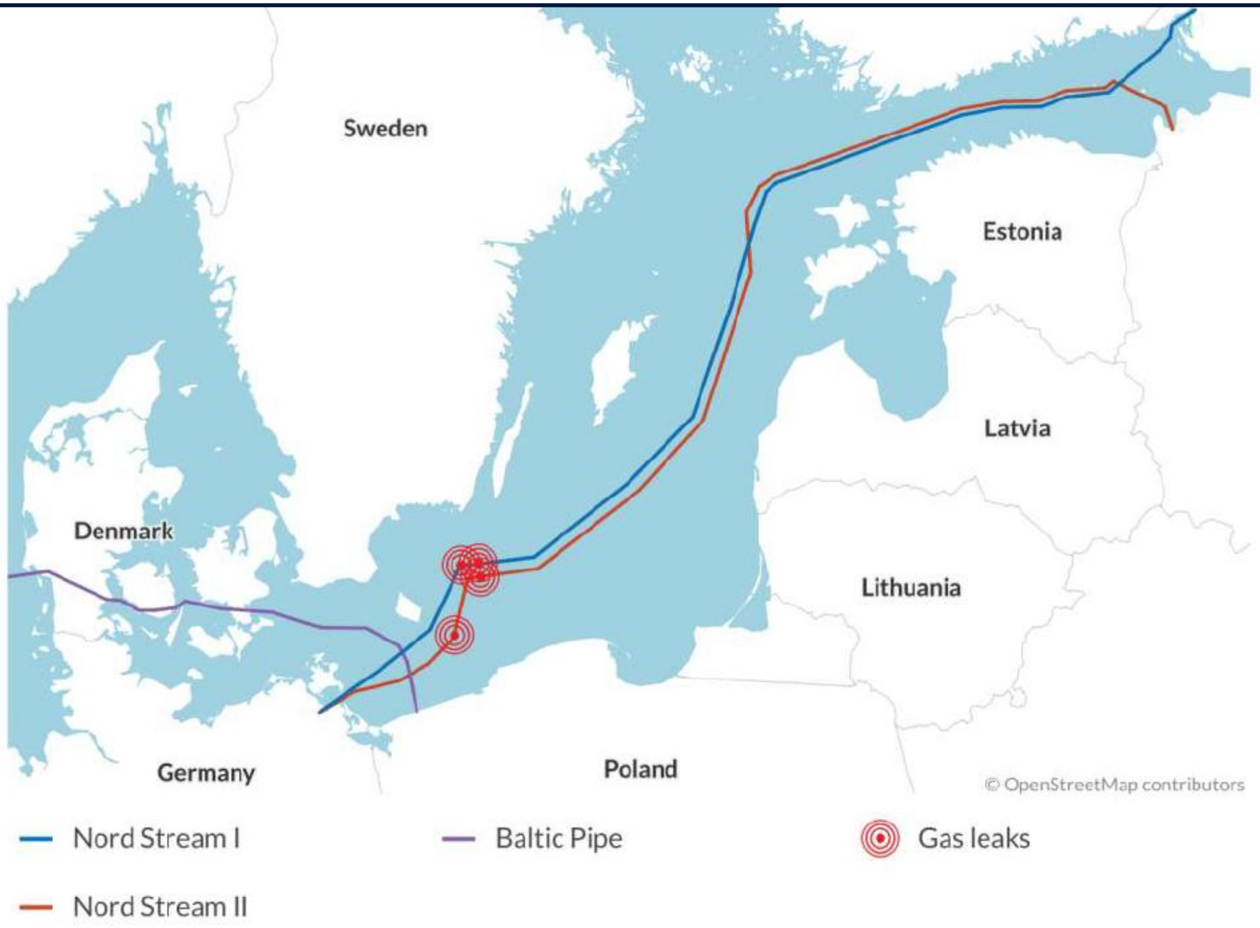
Submarine Power Distribution Cables

Major Distribution Cables

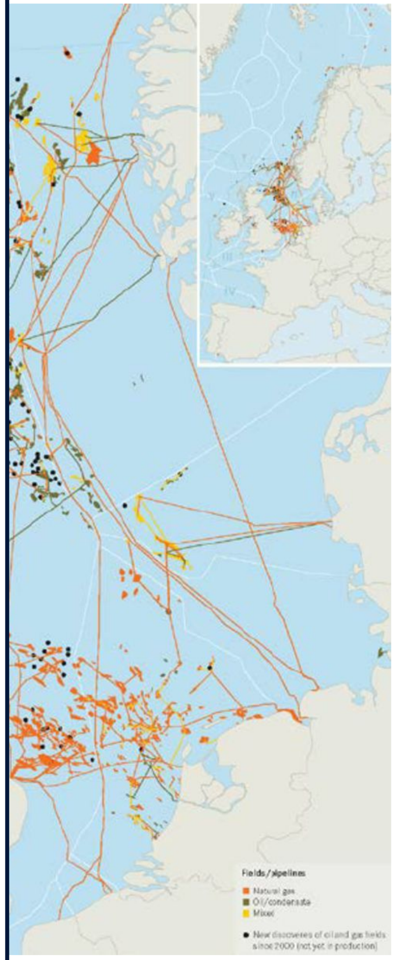
Submarine Gas & Oil Pipelines



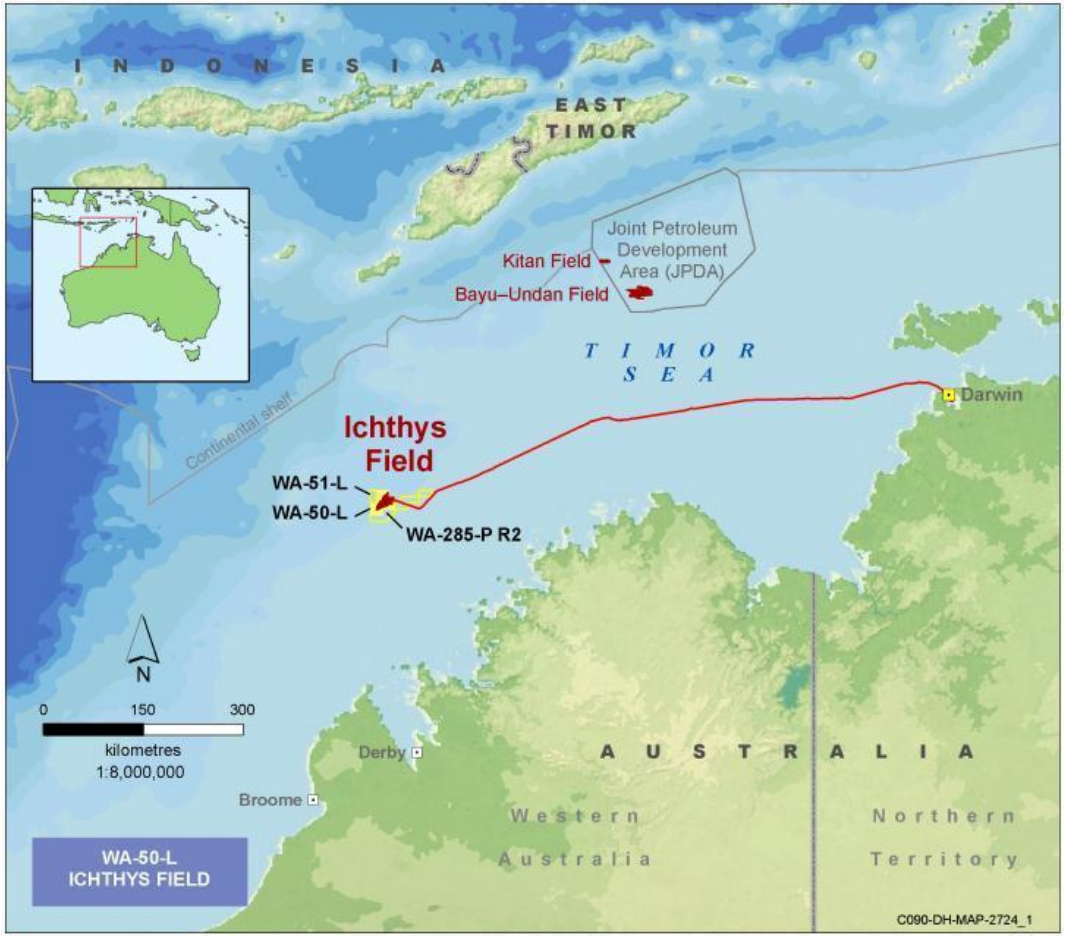


The Nord Stream leaks have stoked fears of further sabotage in Norway, which has become Europe's main oil and gas supplier amid the Ukraine war thanks in part to the new 900-kilometer-long Baltic Pipe.

Source: Reuters

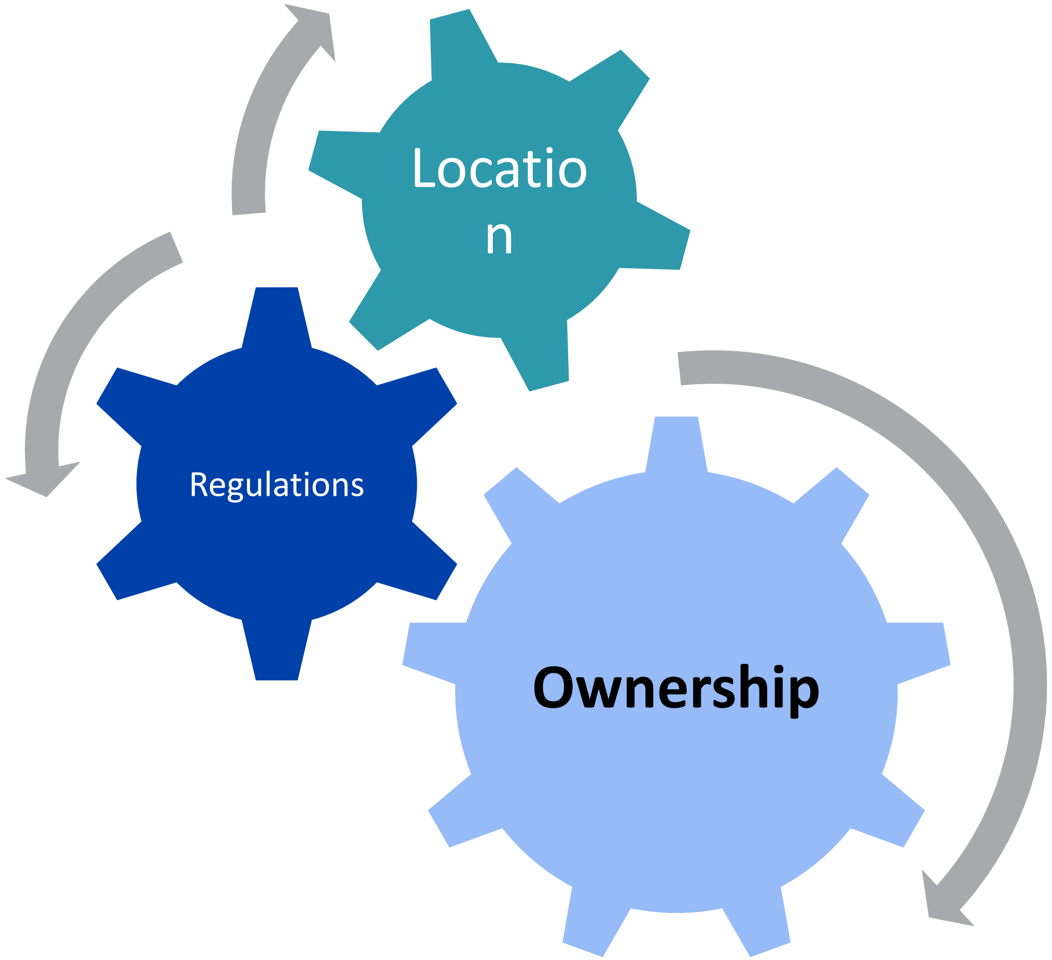


Submarine Gas & Oil Pipelines



Critical Submarine Infrastructure

Complexities of the problem



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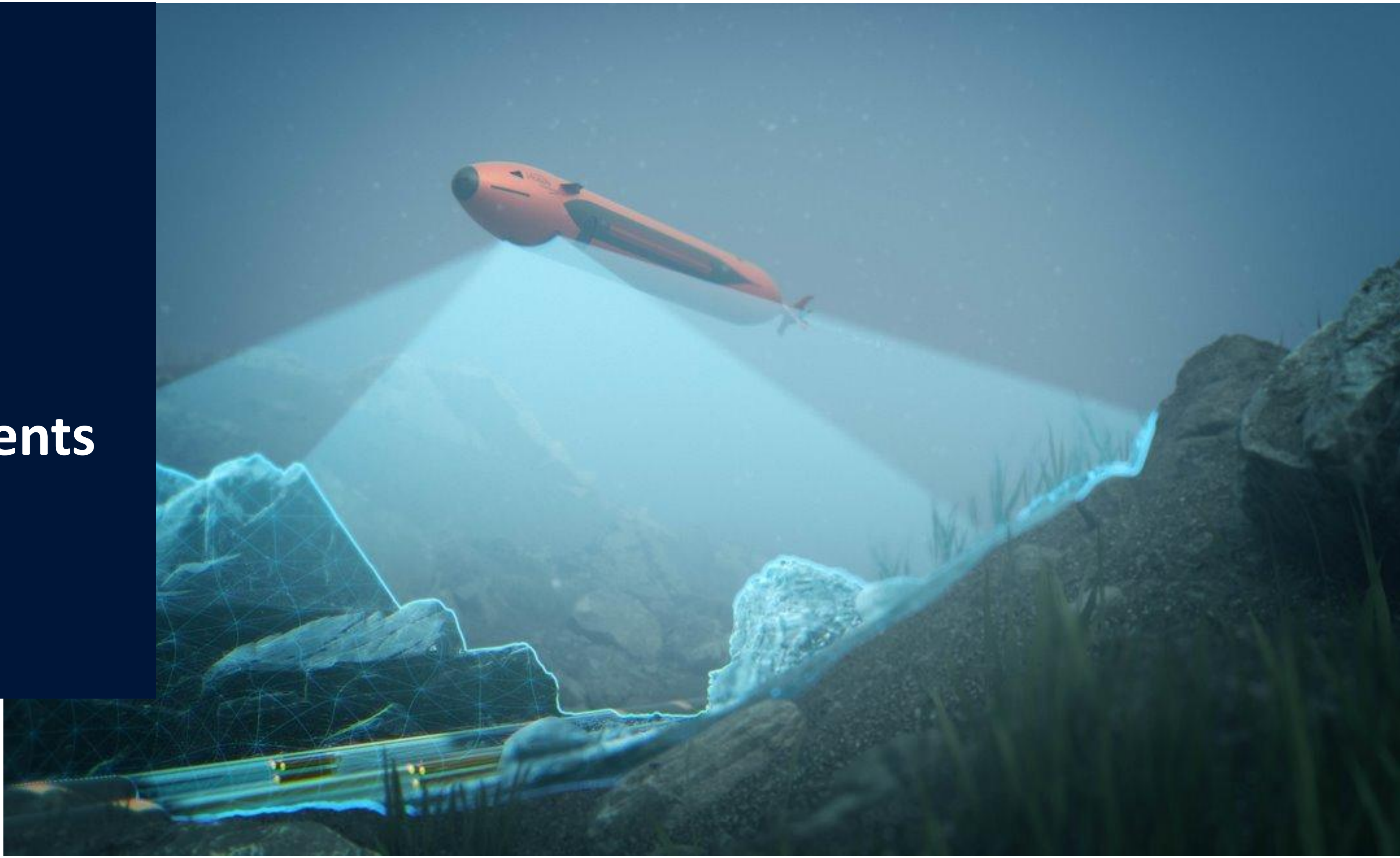
Defining Requirements



CNI security challenges

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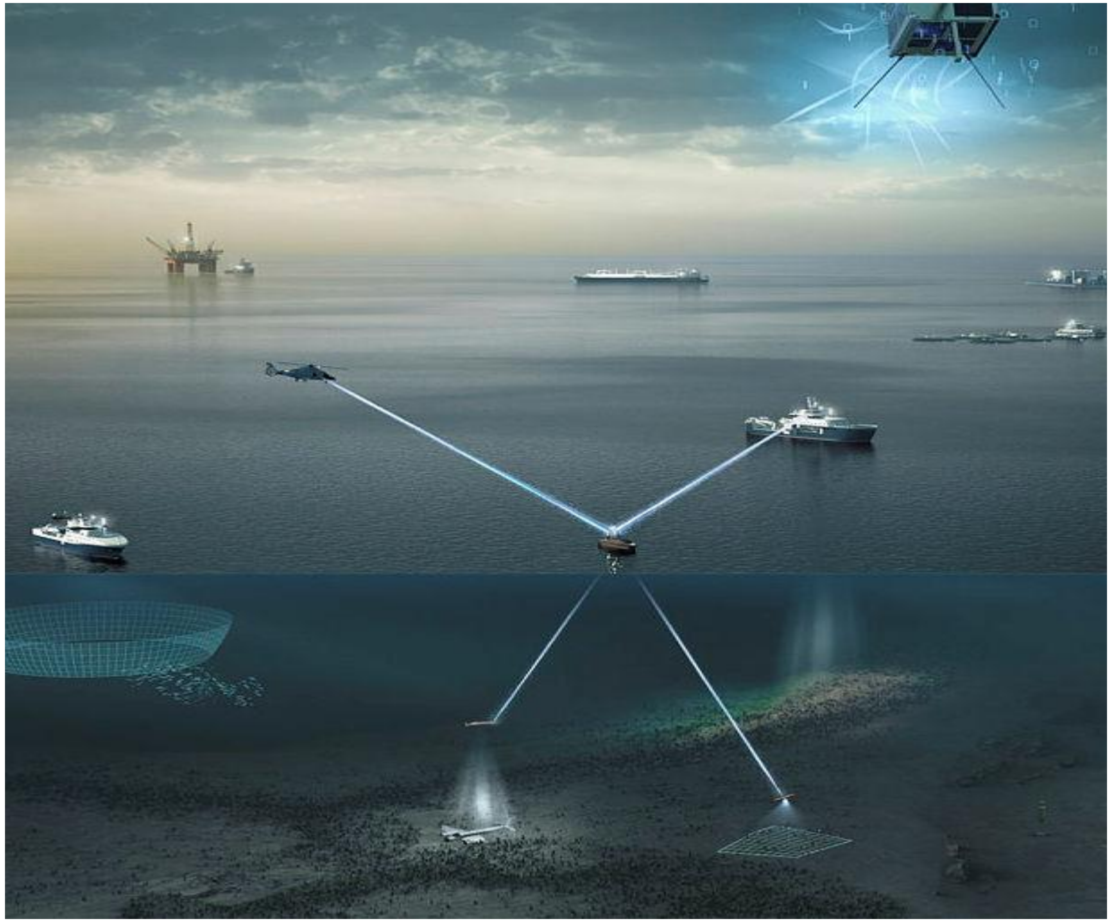
Scenario context

- From deep waters to shoreside
- Massive volume of CNI
- Different types of subsea installations to be protected
- Different actors in theatre
- Challenging weather conditions
- Far from shore, limited support
- Transnational systems

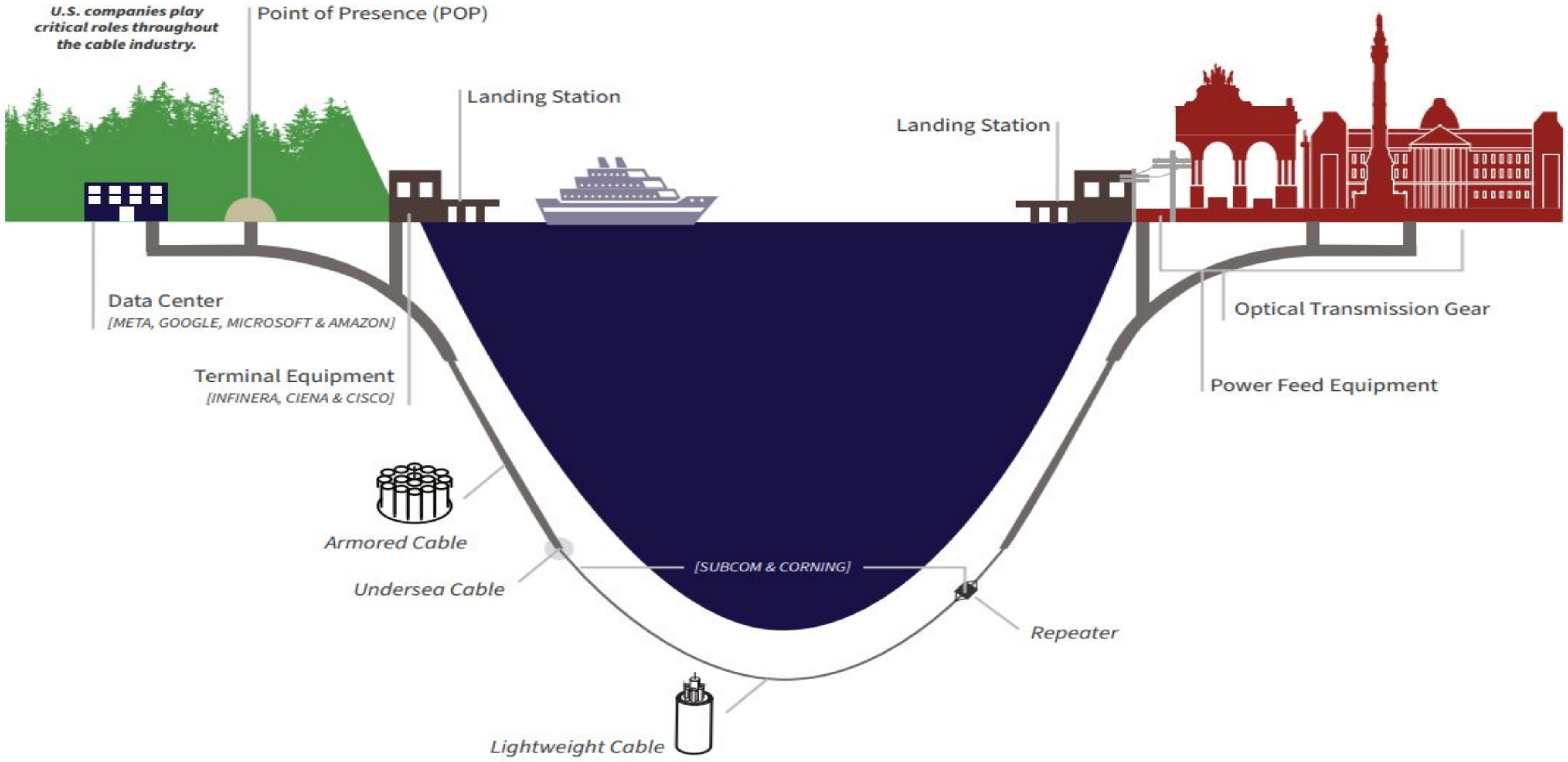
Possible threats and objects

- Terrorism
- Sabotage
- Foreign Intelligence activity
- Malfunction
- Unknown UUV´s
- Mines / IEDs
- Divers
- Trawling
- Listening devices



Infrastructure Characteristics

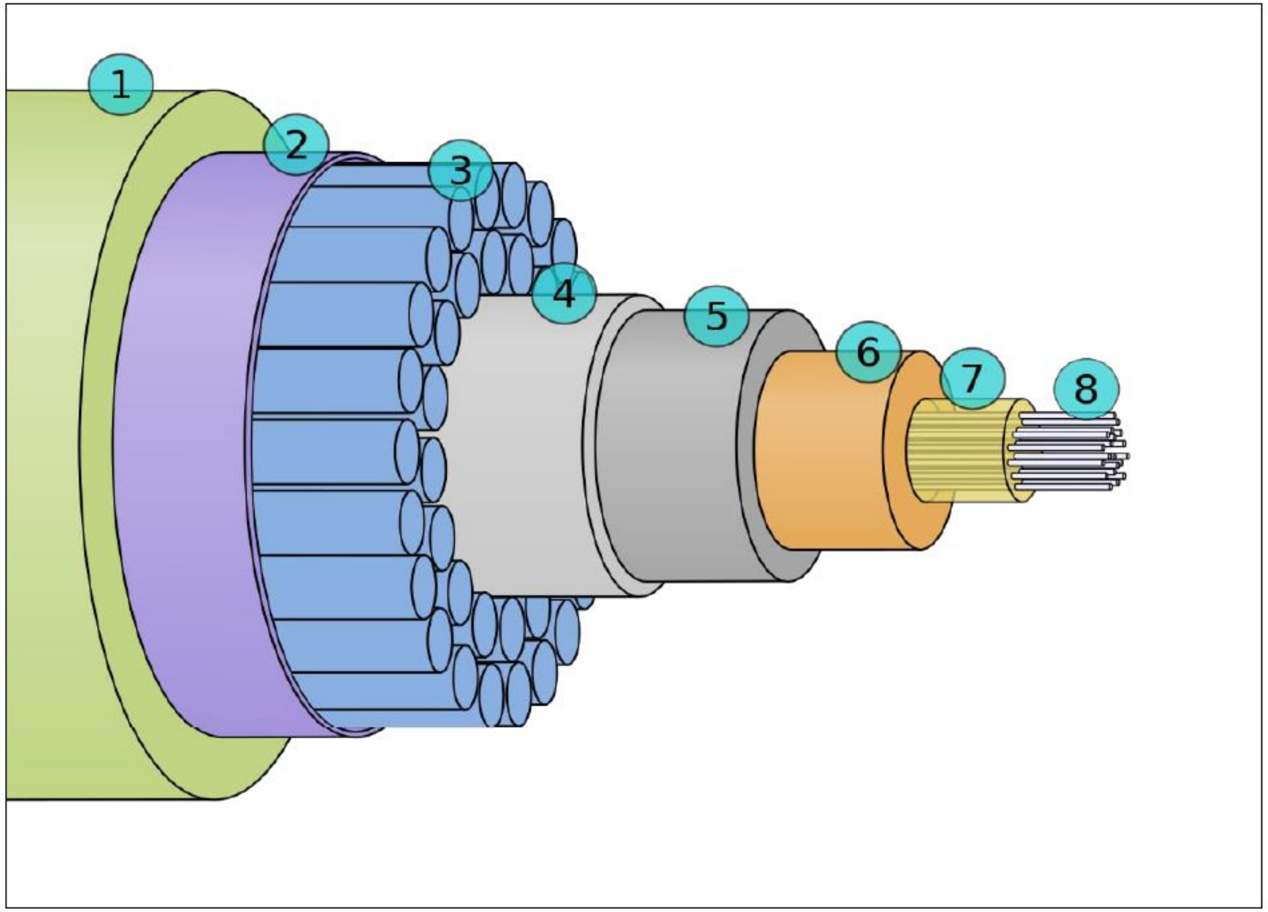
Communications Cables



Source: Google; UK Cable Protection Committee; Alcatel-Lucent Submarine Network.

Infrastructure Characteristics

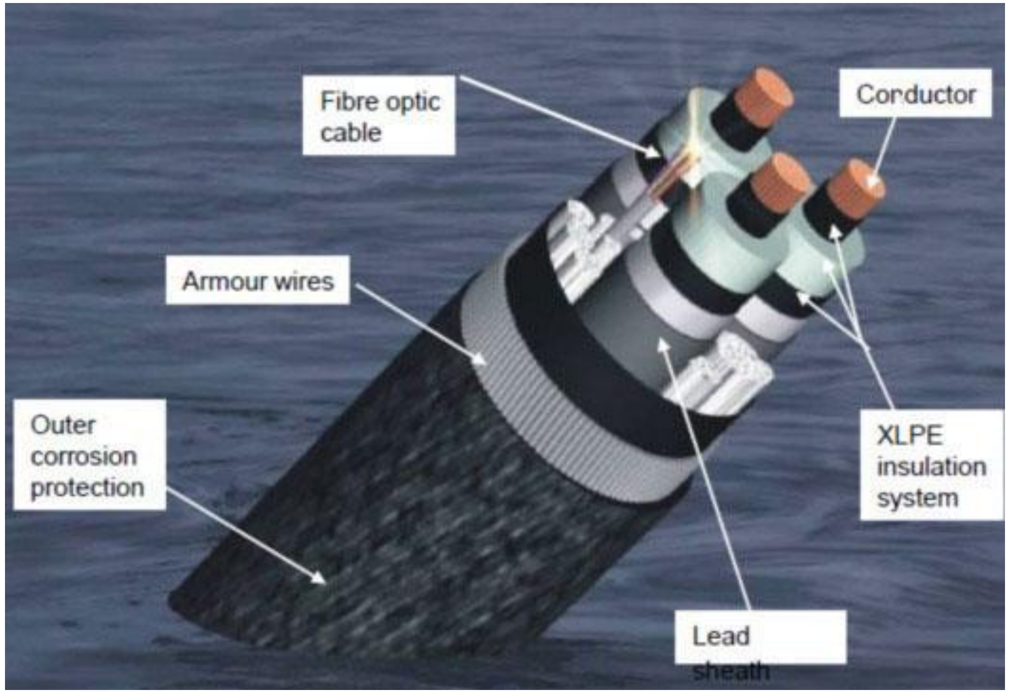
Communications Cables

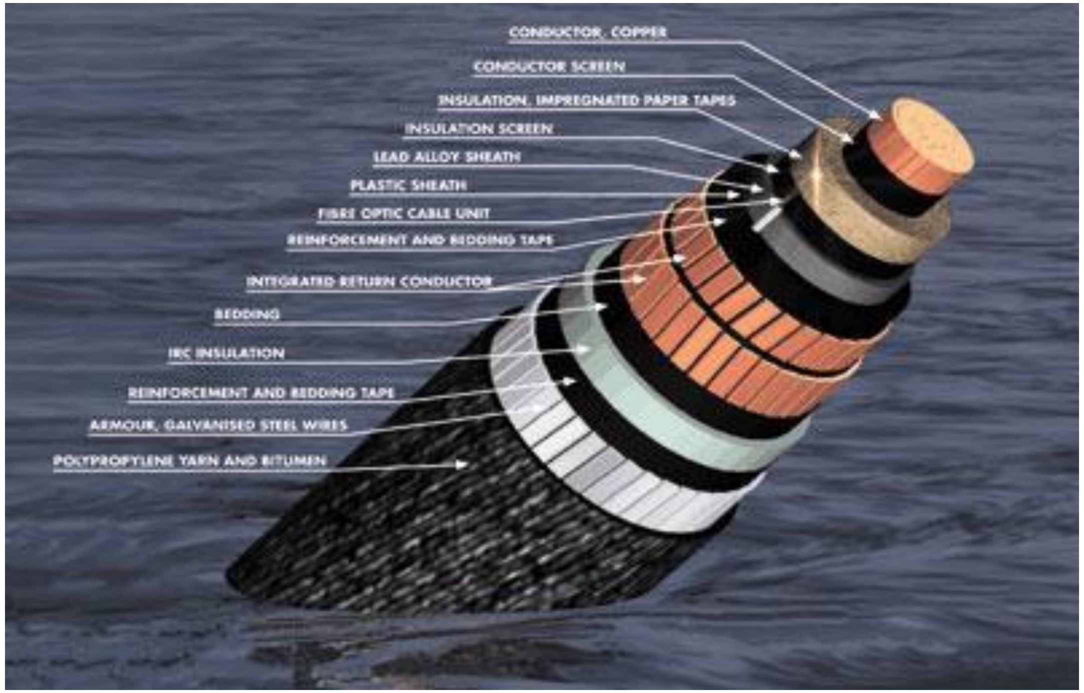


- Double armored cable
  - Used typically in the first 600m near shore
  - Typical diameter: ~40 mm
- Single armored cable
  - Used in intermediate waters 600-2000m
  - Typical diameter: ~25 mm
- Light-weight cable
  - Used in deep water beyond 2000m
  - Typical diameter: ~15 mm

Source: Oona Räisänen, *Submarine Cable Cross-Section 3D Plain*, Public Domain, accessed November 30, 2021, https://commons.wikimedia.org/wiki/File:Submarine_cable_cross-section_3D_plain.svg.

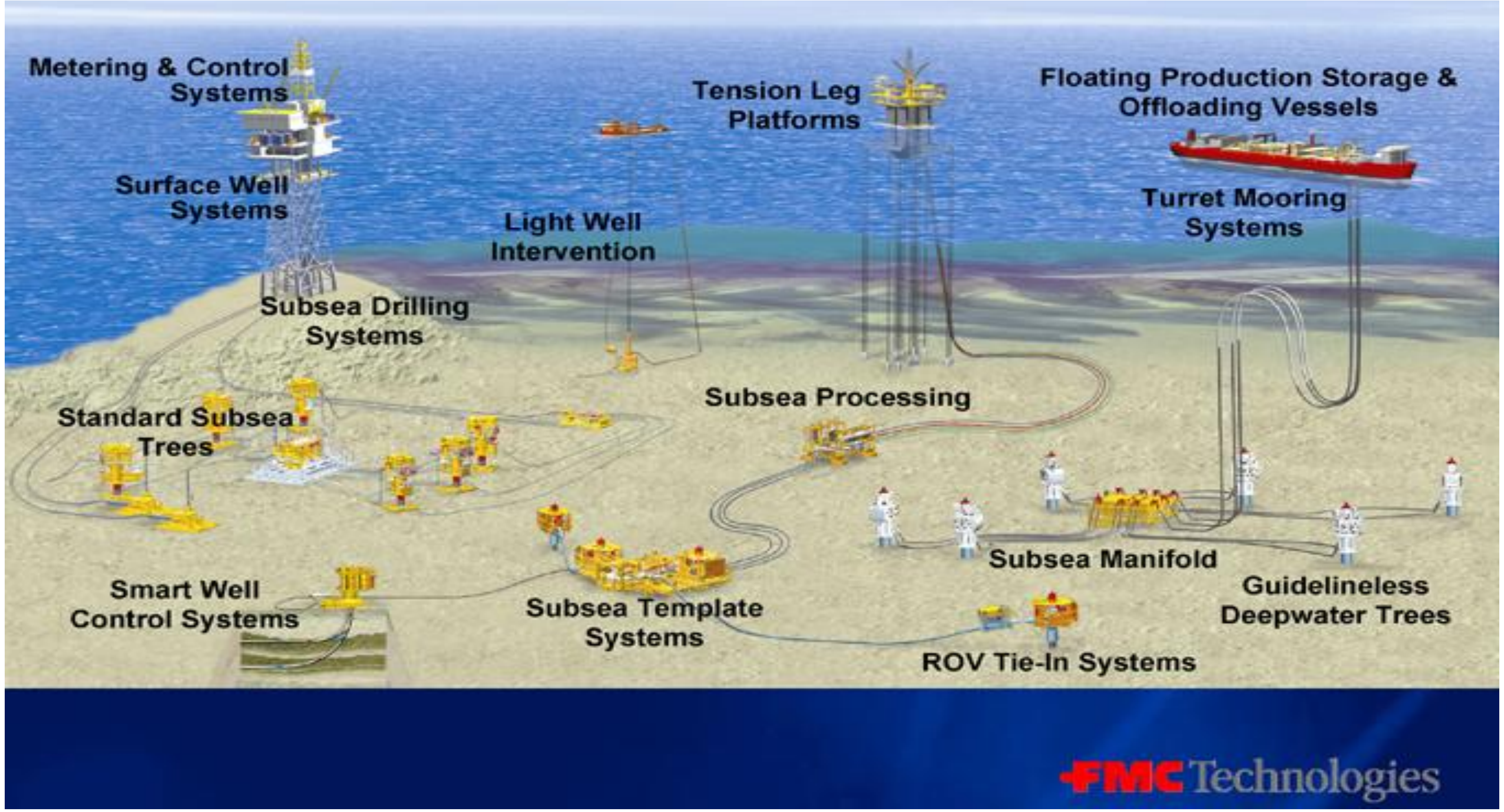
Submarine Power Cables



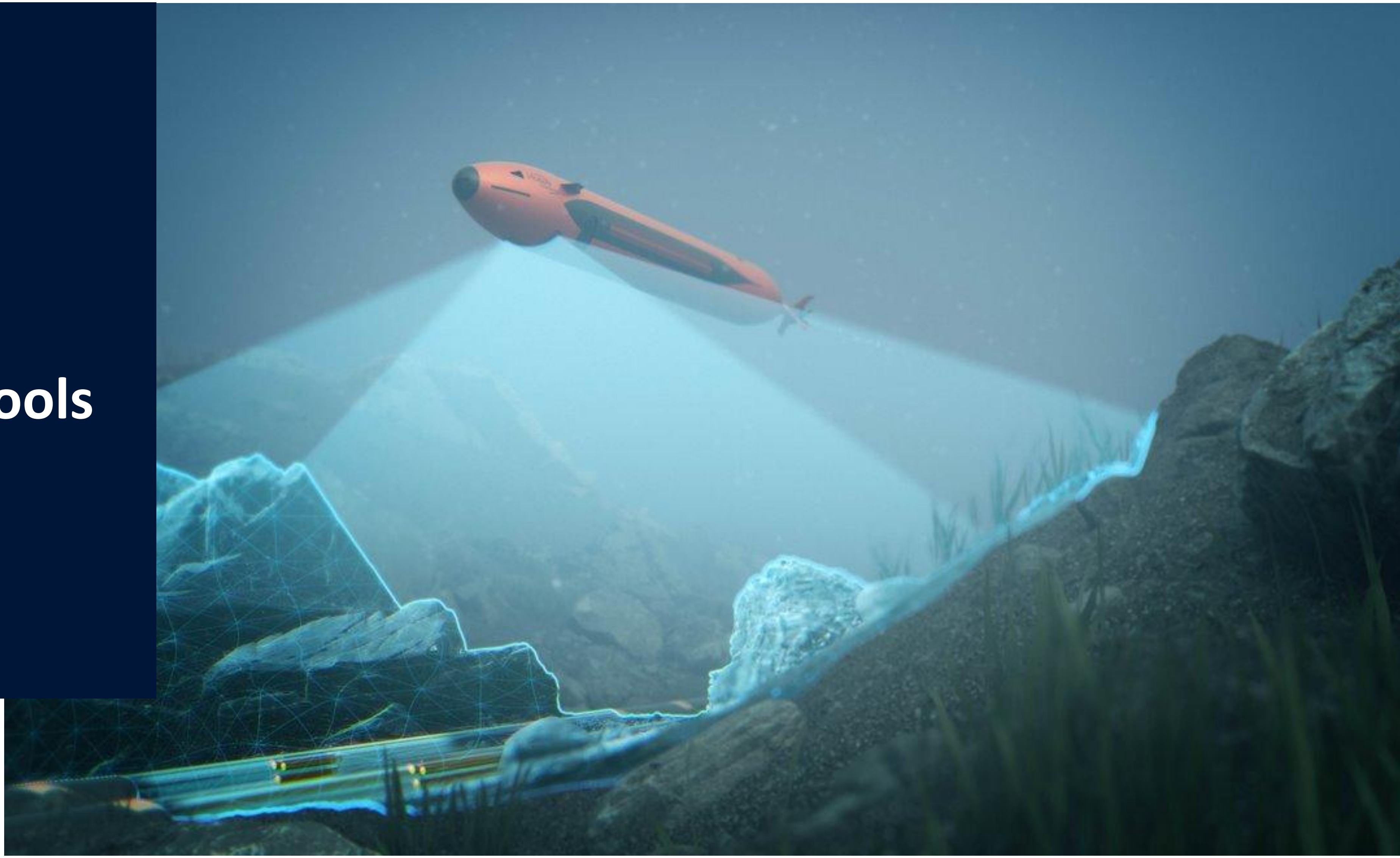


Typical diameter: 90-1000 mm

Oil and Gas Infrastructure

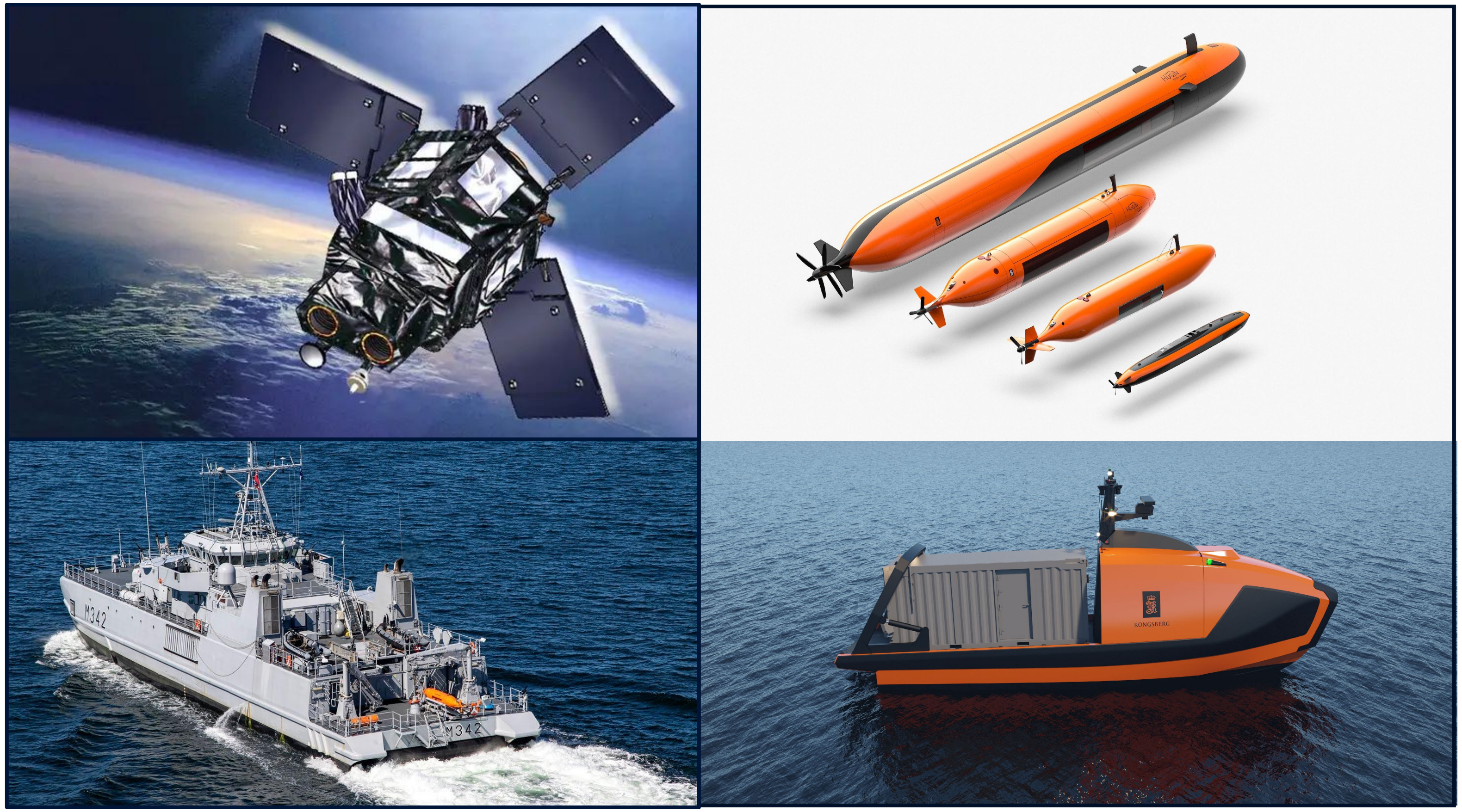


Readily Available Tools and CONOPS



How to Handle the Challenges

- Frequent, persistent surveillance operations
- Different sensors and platforms for complete picture
- High resolution for small objects close to infrastructure
- Cost-effective solutions with reduced OPEX/CAPEX
- Highly scalable
- Precision navigation accuracy
- Rapidly available actionable information



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UUVs: Optimal Tool for Subsea CNI Surveillance

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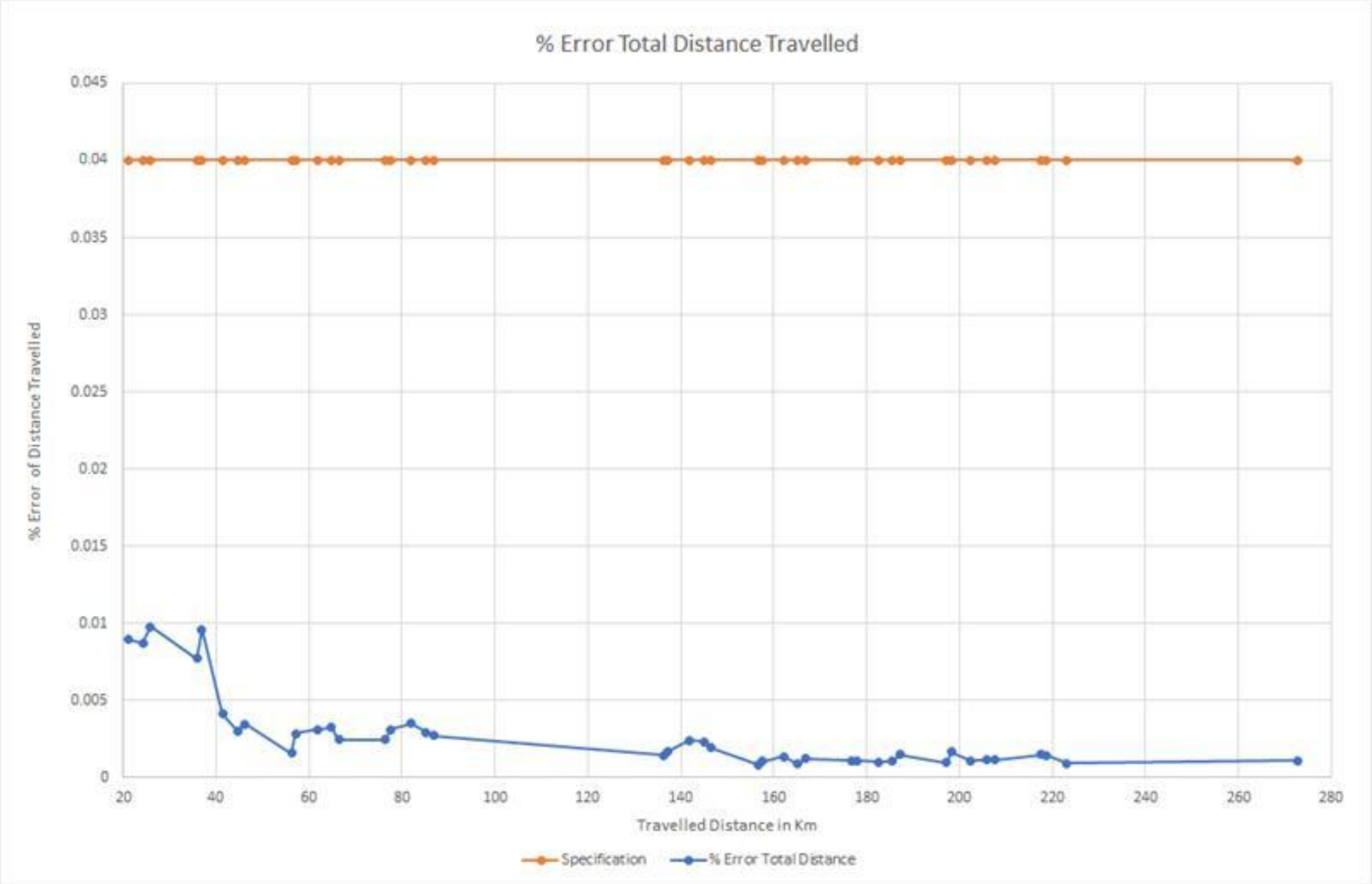
Long Range Navigation

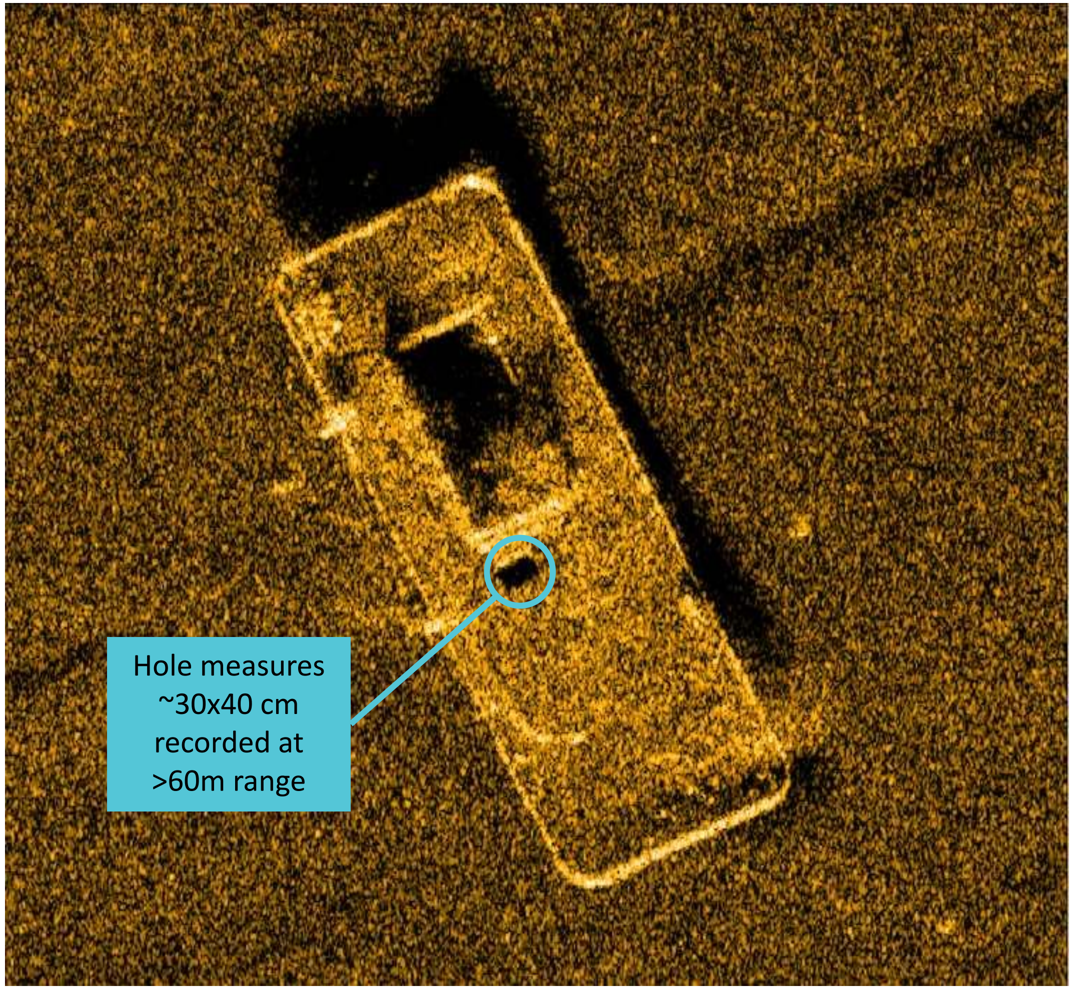
Enabling unsupervised operations

- Sunstone® is the in-situ navigation processor taking inputs from a high grade IMU, DVL, depth sensor, compass etc.
- This enables long range missions while retaining navigation certainty
- Demonstratable performance of **0.005-0.01% of distance travelled**
- Sunstone also includes TerrainNav and UTP (single beacon navigation)



Primary Sensor: Synthetic Aperture Sonar

Making sense of a cluttered world



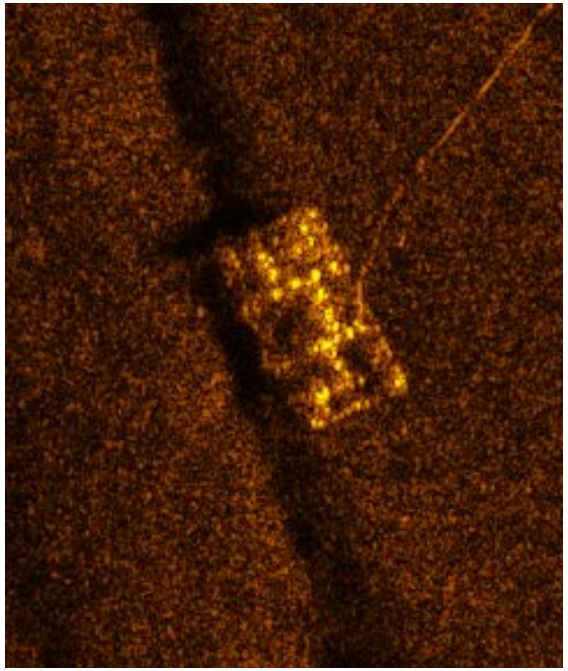
Kongsberg HISAS 1032

- Prototype developed 2001-2005 in partnership with FFI
- Capable of coverage rates up to 4.5 km^2/hr
- Imagery resolution of 5x5 cm
- In-mission processing for faster time to actionable information
  - Allows in-mission target detection
- Produces multiple data sets:
  - Real aperture sidescan imagery
  - Real aperture sidescan bathymetry
  - SAS imagery
  - SAS bathymetry
  - Spot processing

HISAS 1032: Resolution

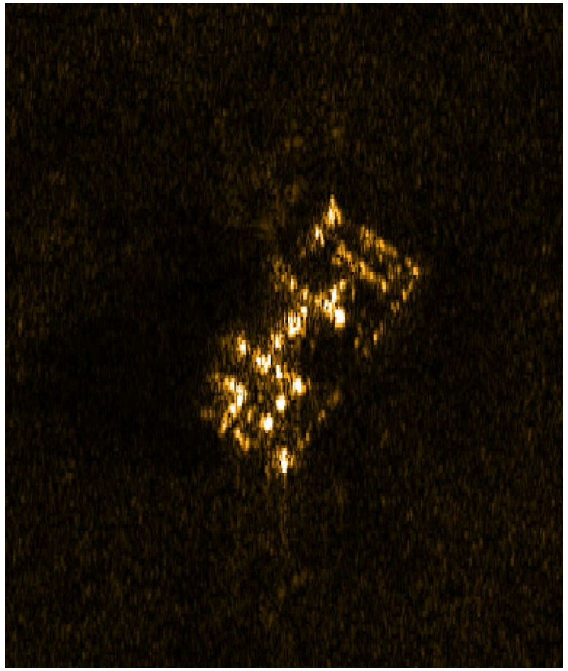
The target:

5 cm, 7.5 cm & 12.5 cm targets on a plastic, water-filled frame



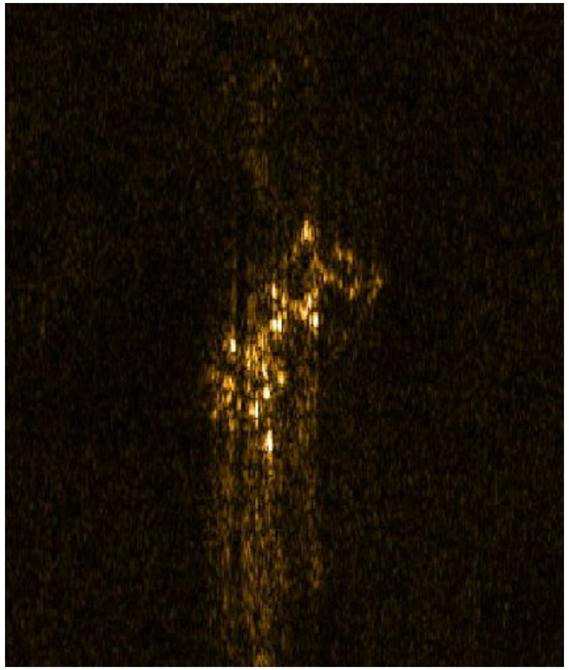
HISAS 1032 Dual Rx Imagery

Range to target: 100 m



HISAS 1032 Dual Rx Imagery

Range to target: 300 m



HISAS 1032 Dual Rx Imagery

Range to target: 500 m

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Coverage Rate

Visualizing what is achievable

FOOTBALL PITCH

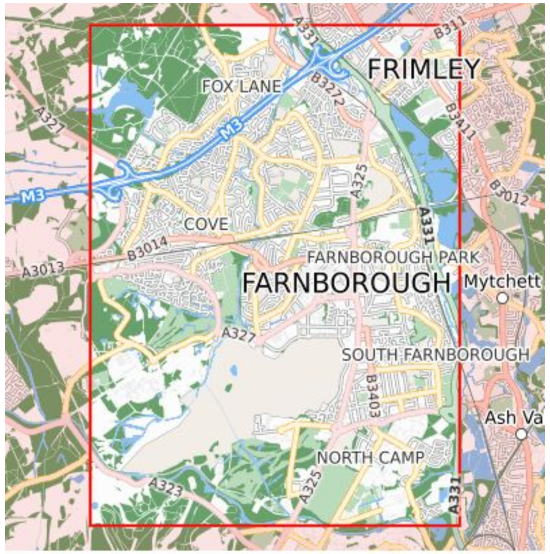
0.07 km^2

Covered in 56 seconds

IKEA STORE

0.35 km^2

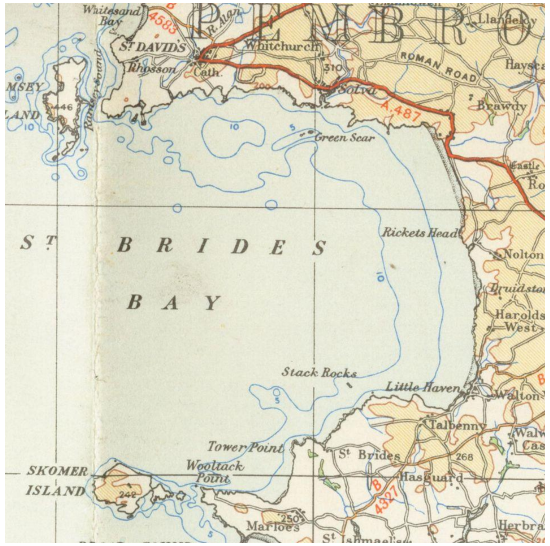
Covered in 4 min 40 seconds



CITY OF FARNBOROUGH, UK

10.5 km^2

Covered in 2 hours 20 minutes

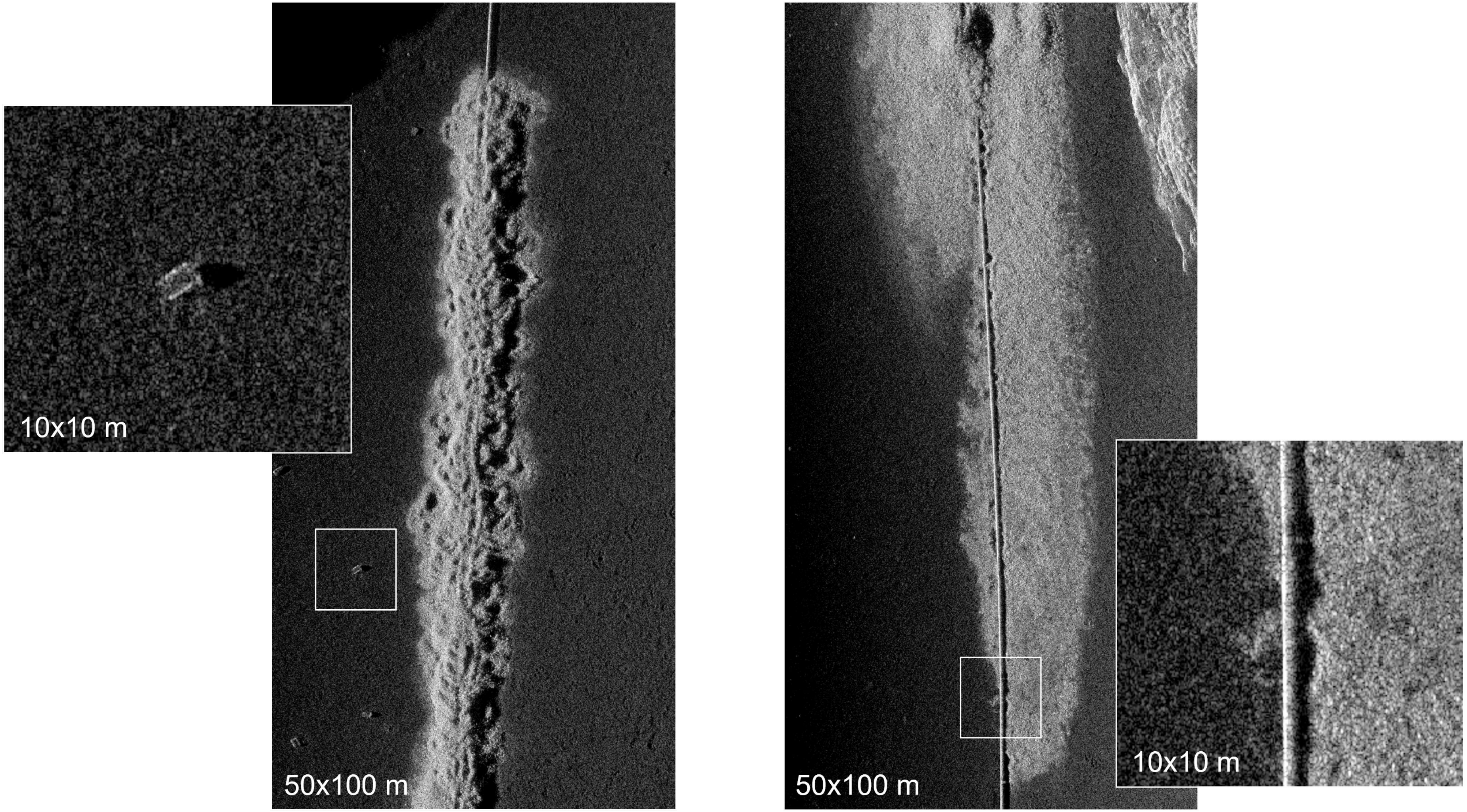


ST. BRIDES BAY

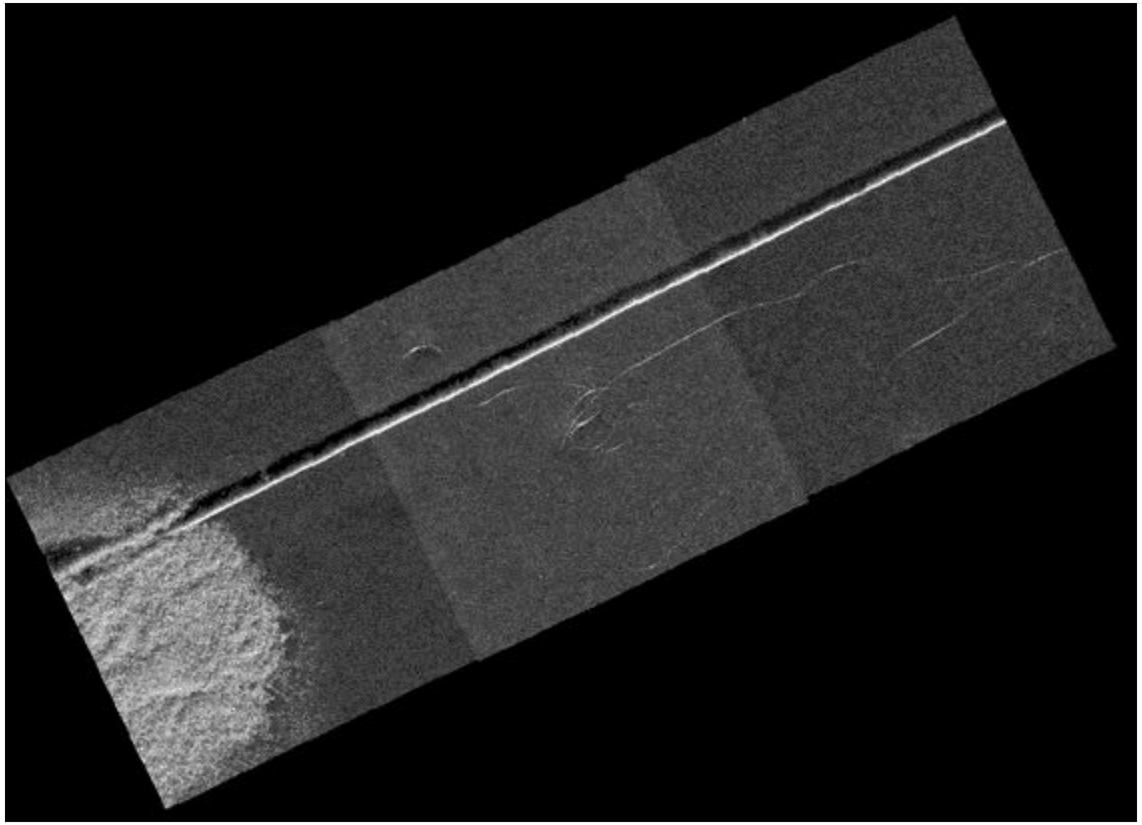
59 km^2

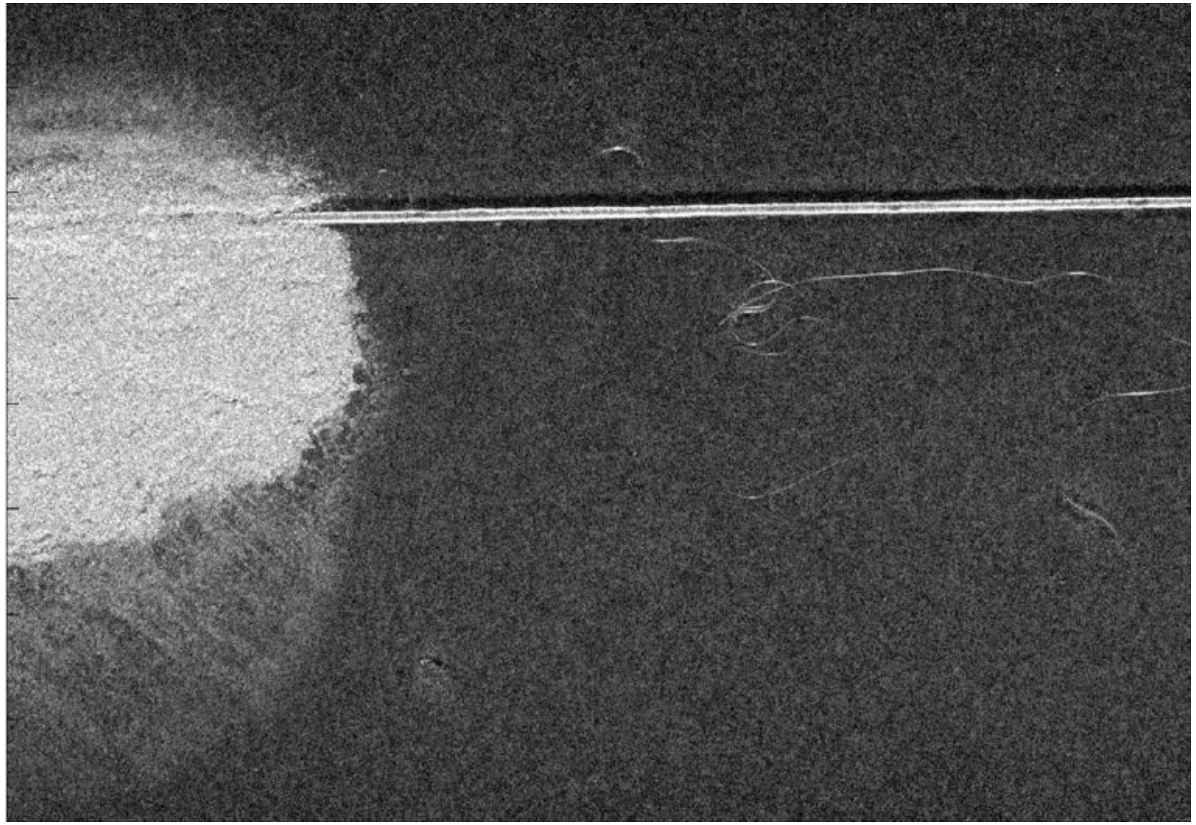
Covered in 39 hours 7 minutes

Previous Results



Previous Results





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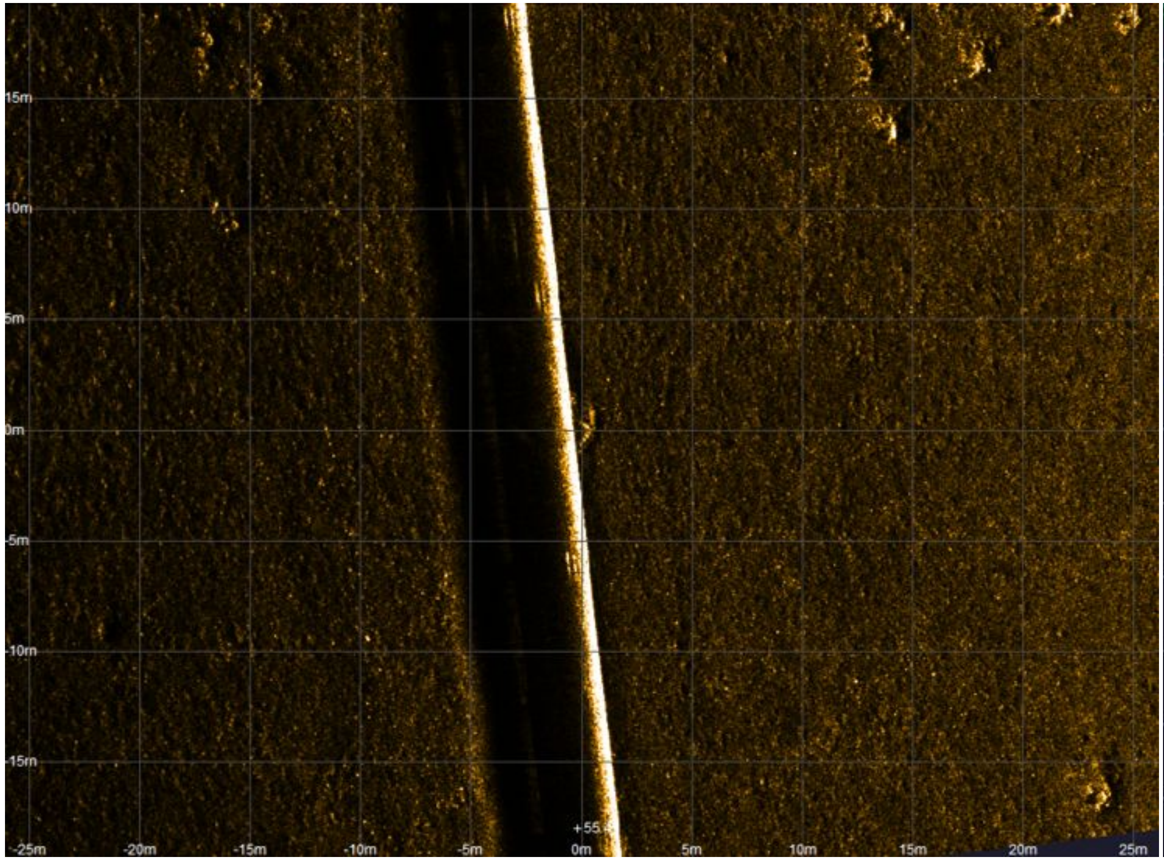

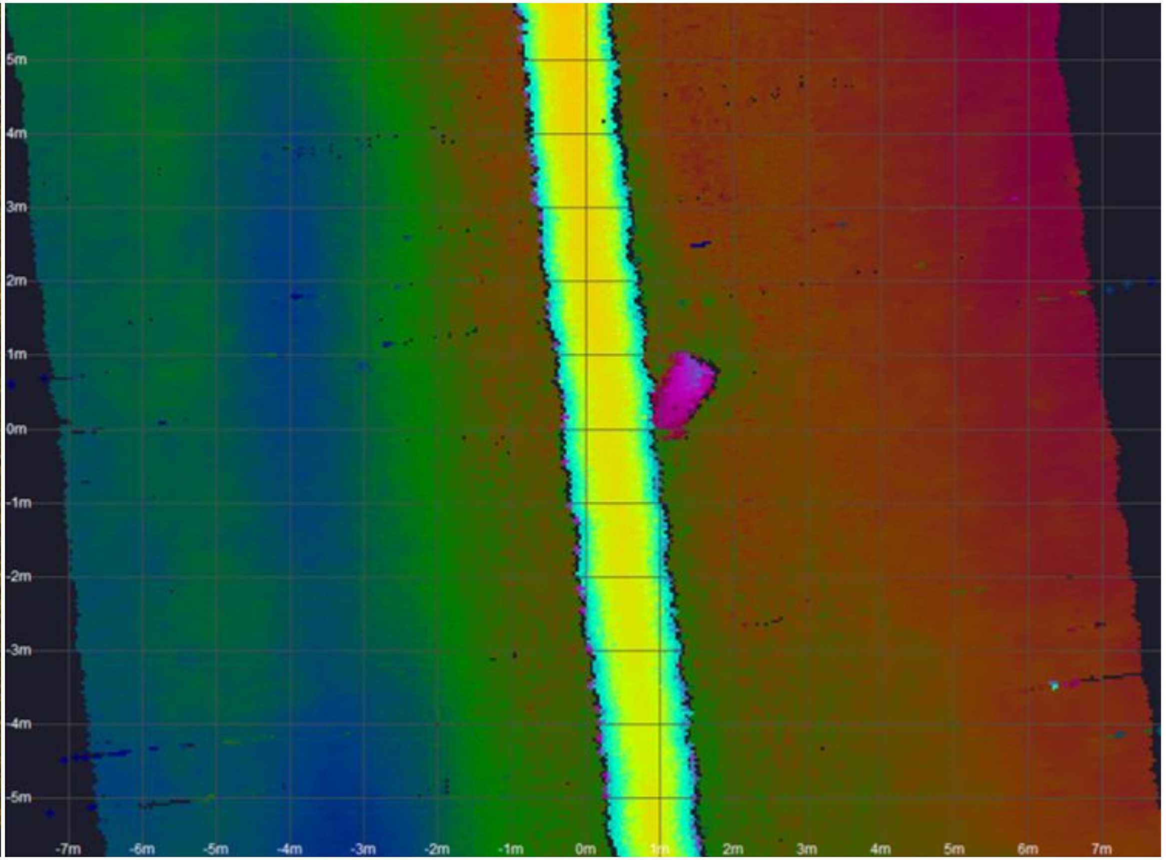

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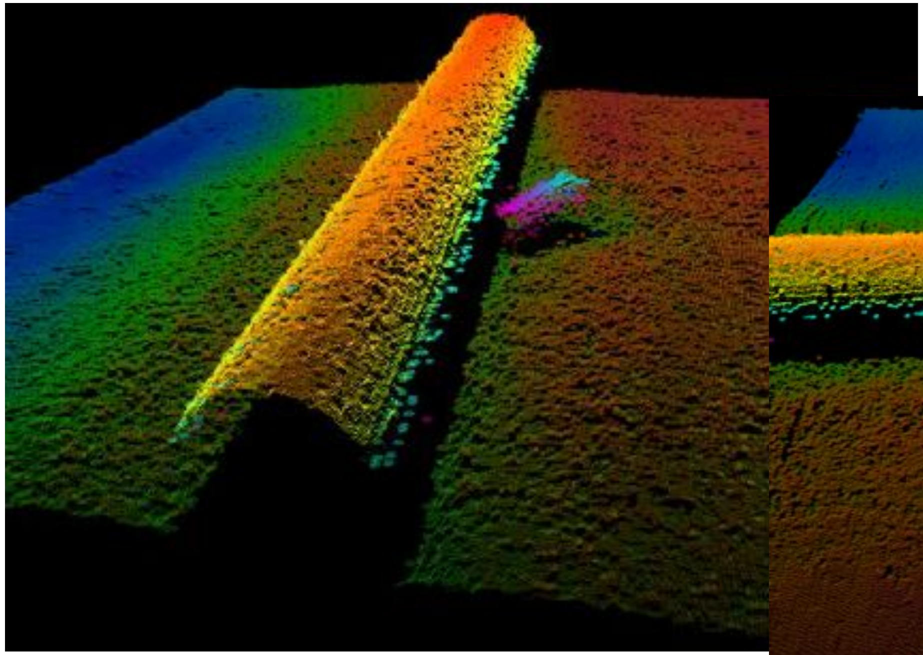
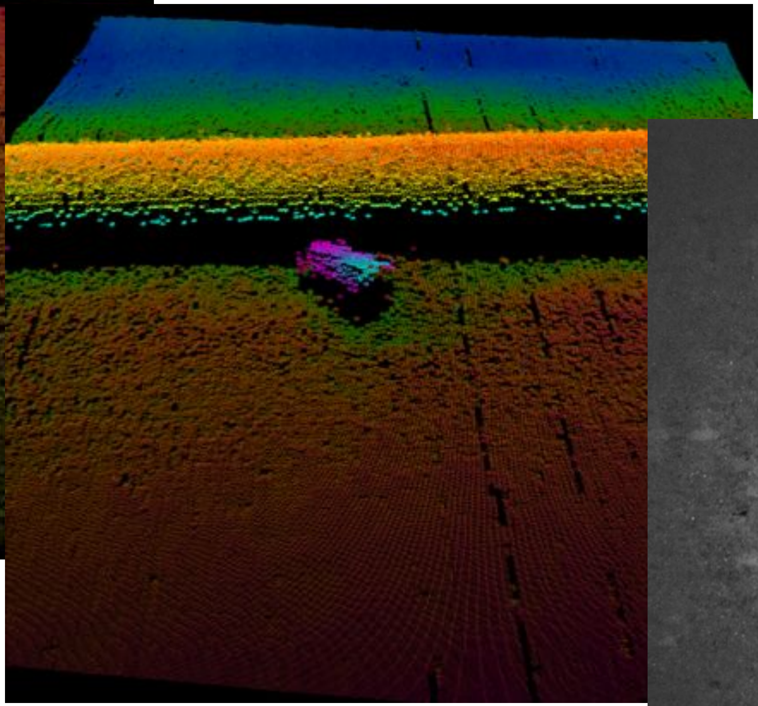
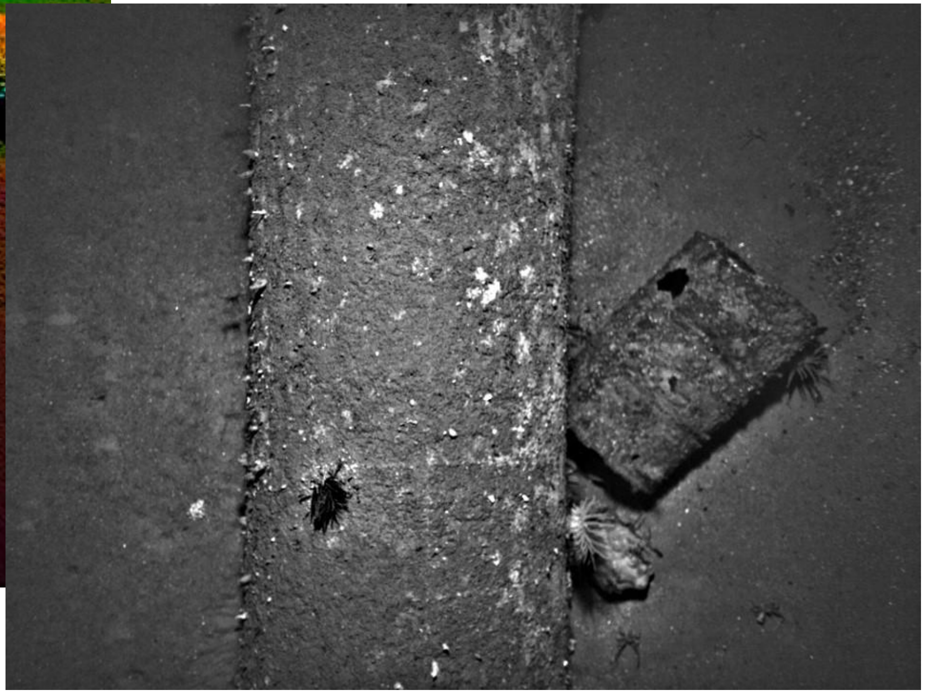


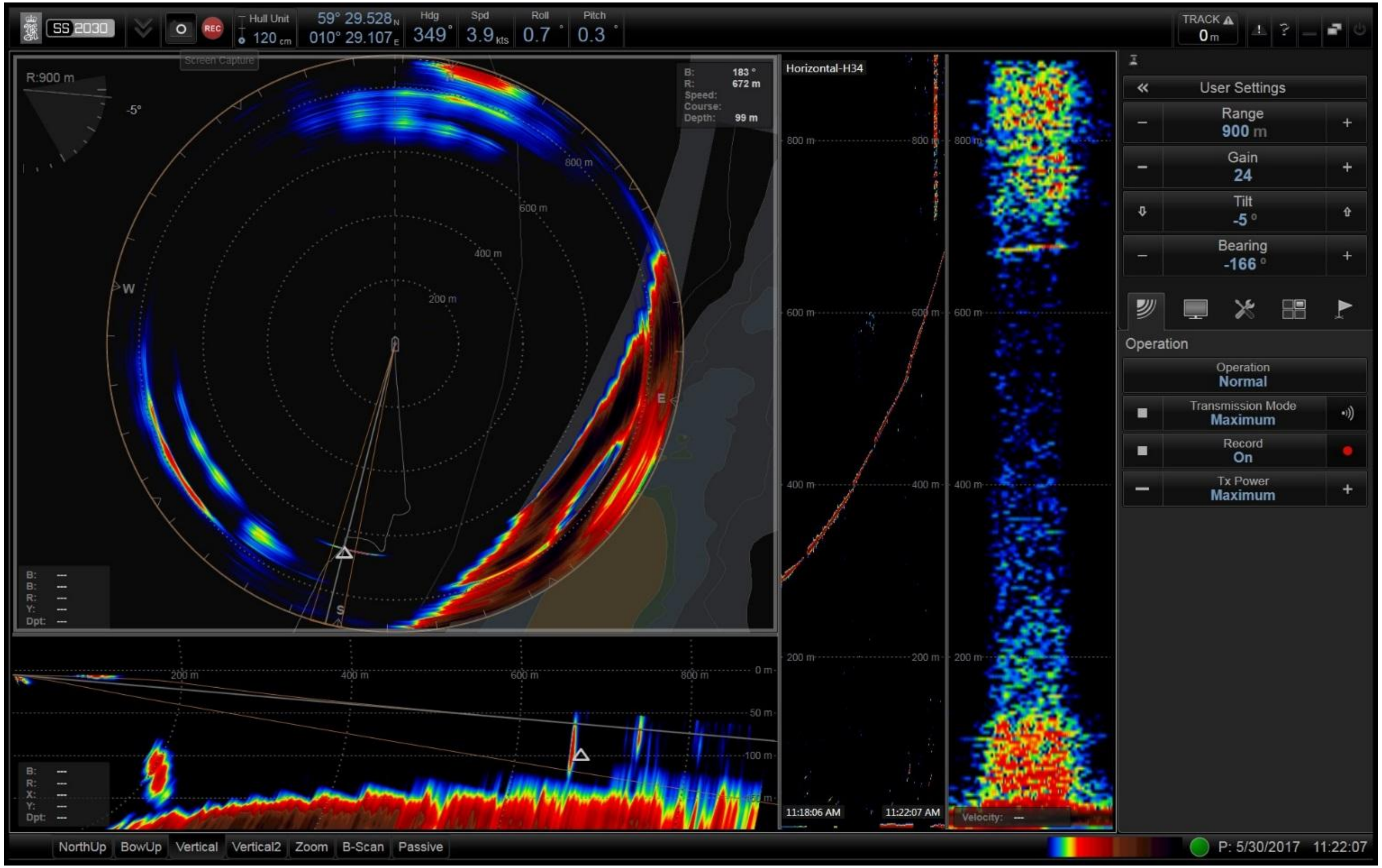




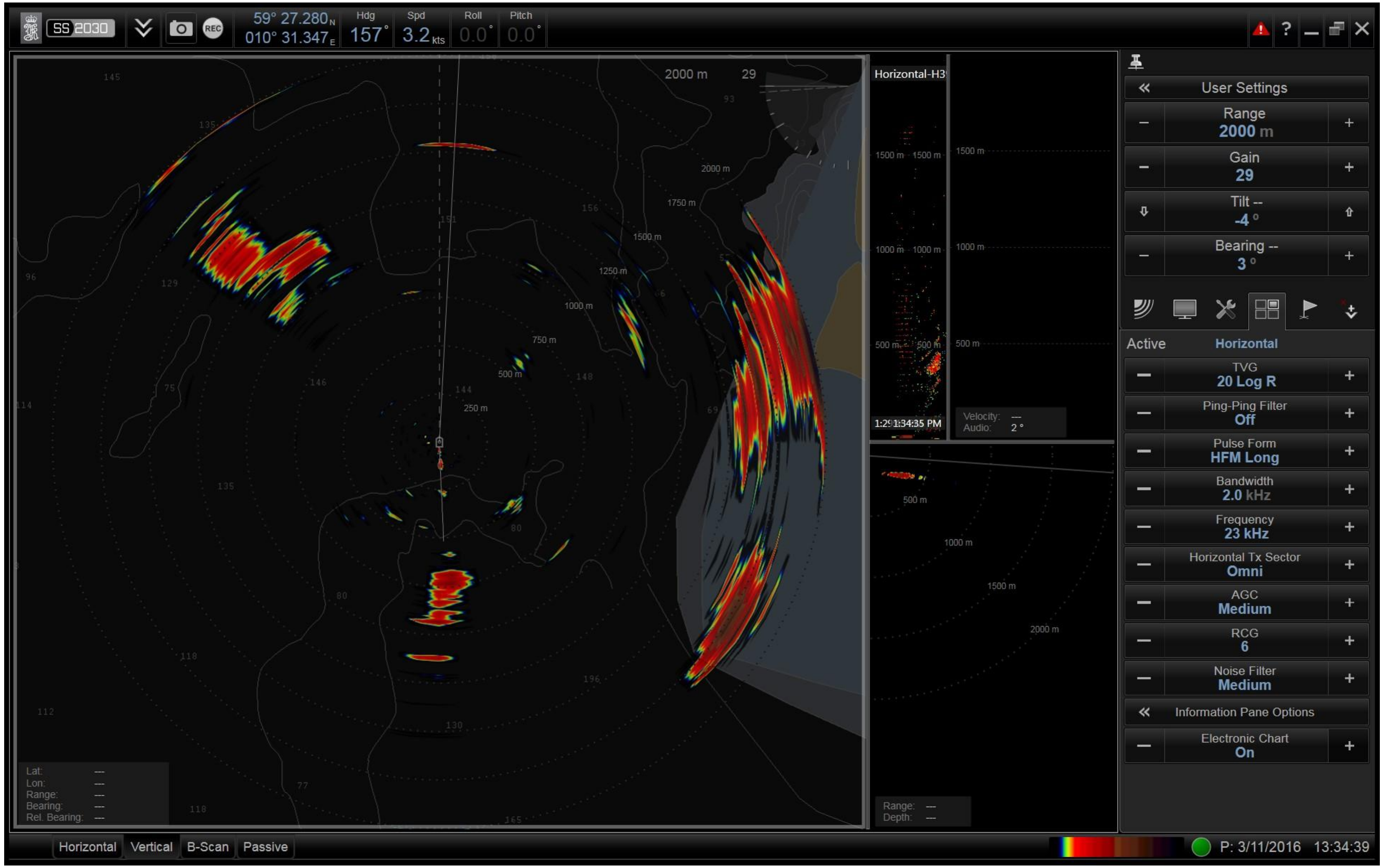
Littoral Naval Sonars

- Light weight and small size
- Variable depth solutions or hull mounted with hoist
- Optimized for shallow waters
- Containerized systems for movement from vessel to vessel
- Small combatants & USV's

Identifying Underwater Threats - Results

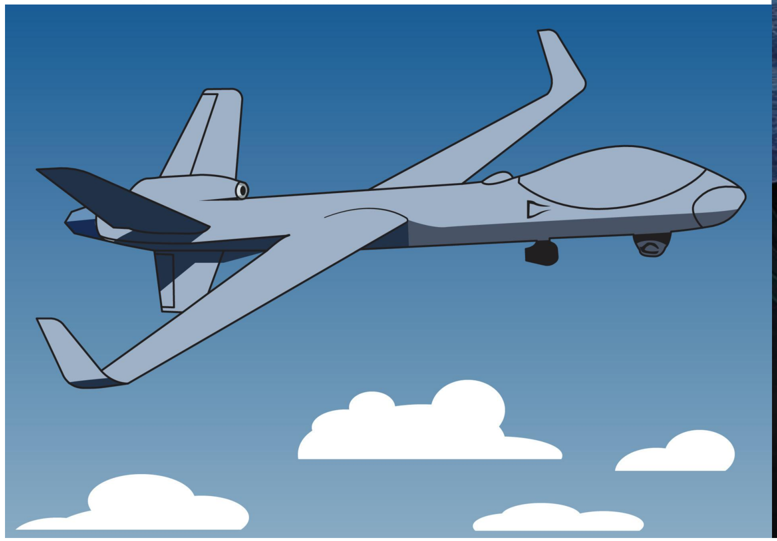


Identifying Underwater Threats - Results



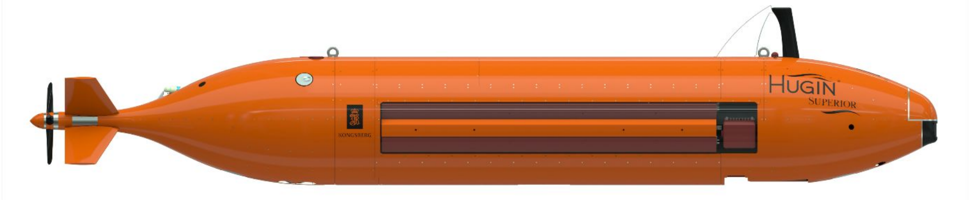
Near Shore & Shallow Water

- Satellite surveillance
- USV equipped for underwater threat detection
- ISR equipped UAV
- SAS equipped UUV
- Small vessel (crewed) or shore-shore ops
- USV based UUV ops in future

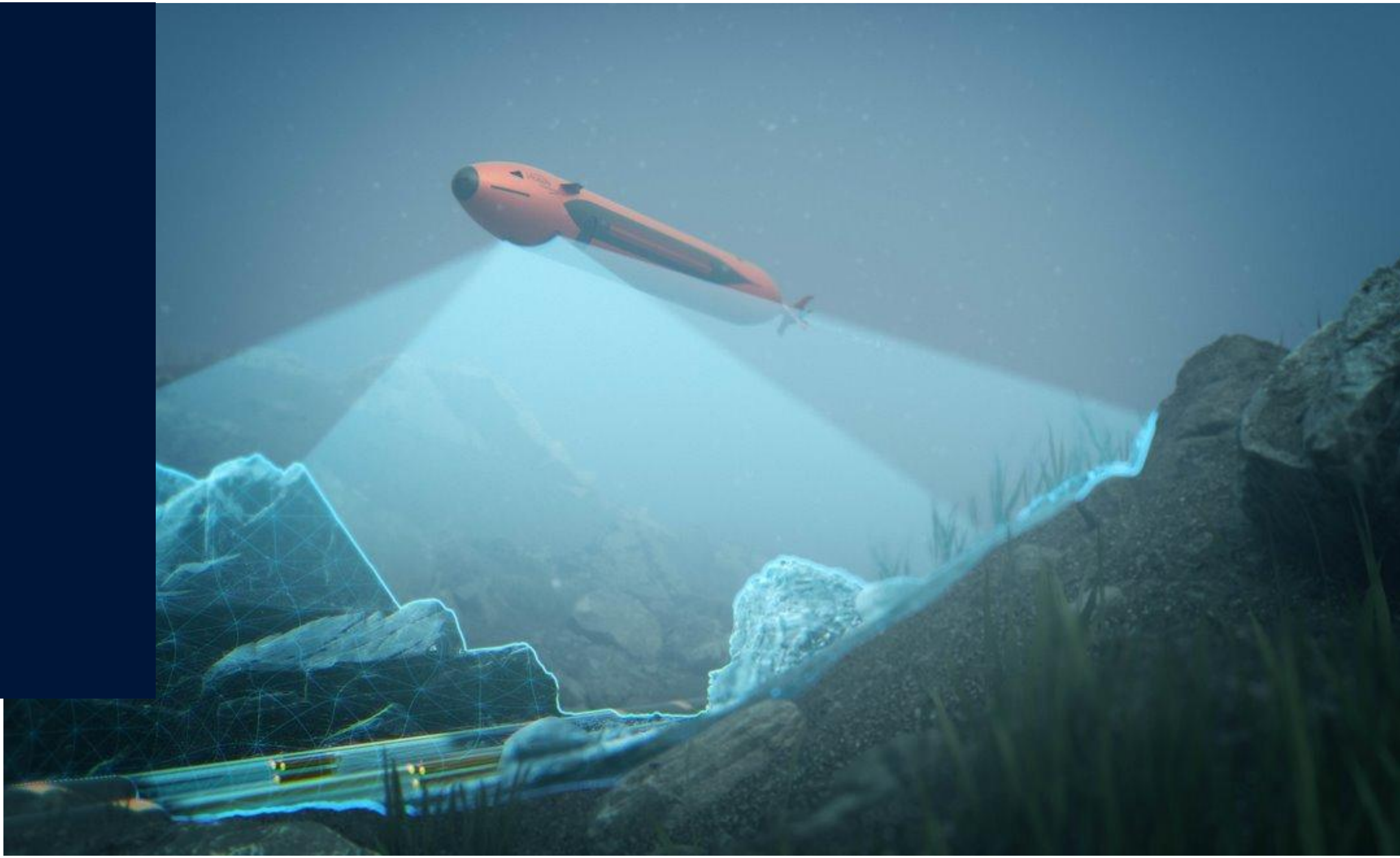


Deep Water Open Ocean

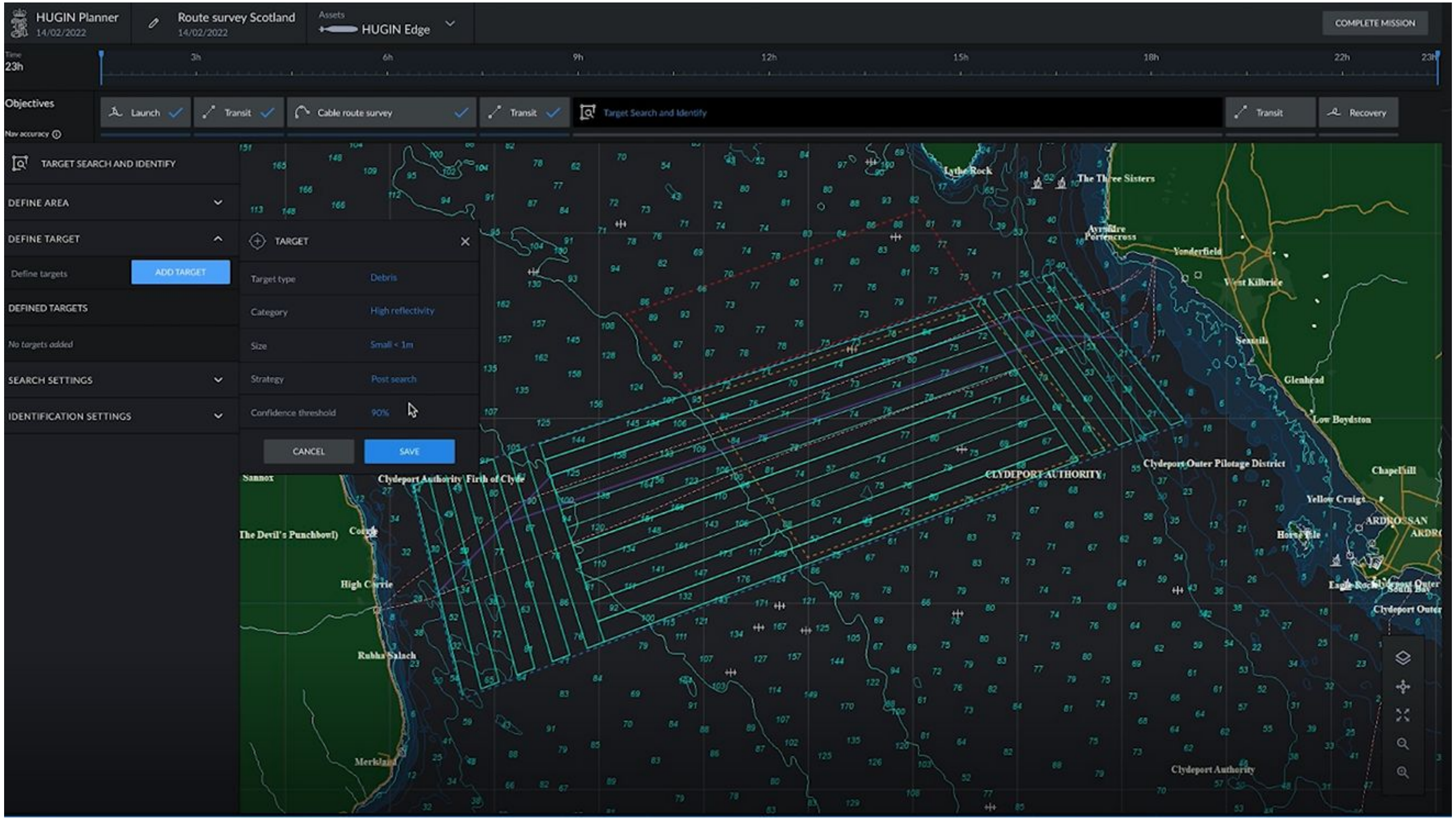
- Satellite surveillance
- SAS equipped deep water UUVs
- Larger vessels, crewed in the near term
- USV based or shore-shore operations in future



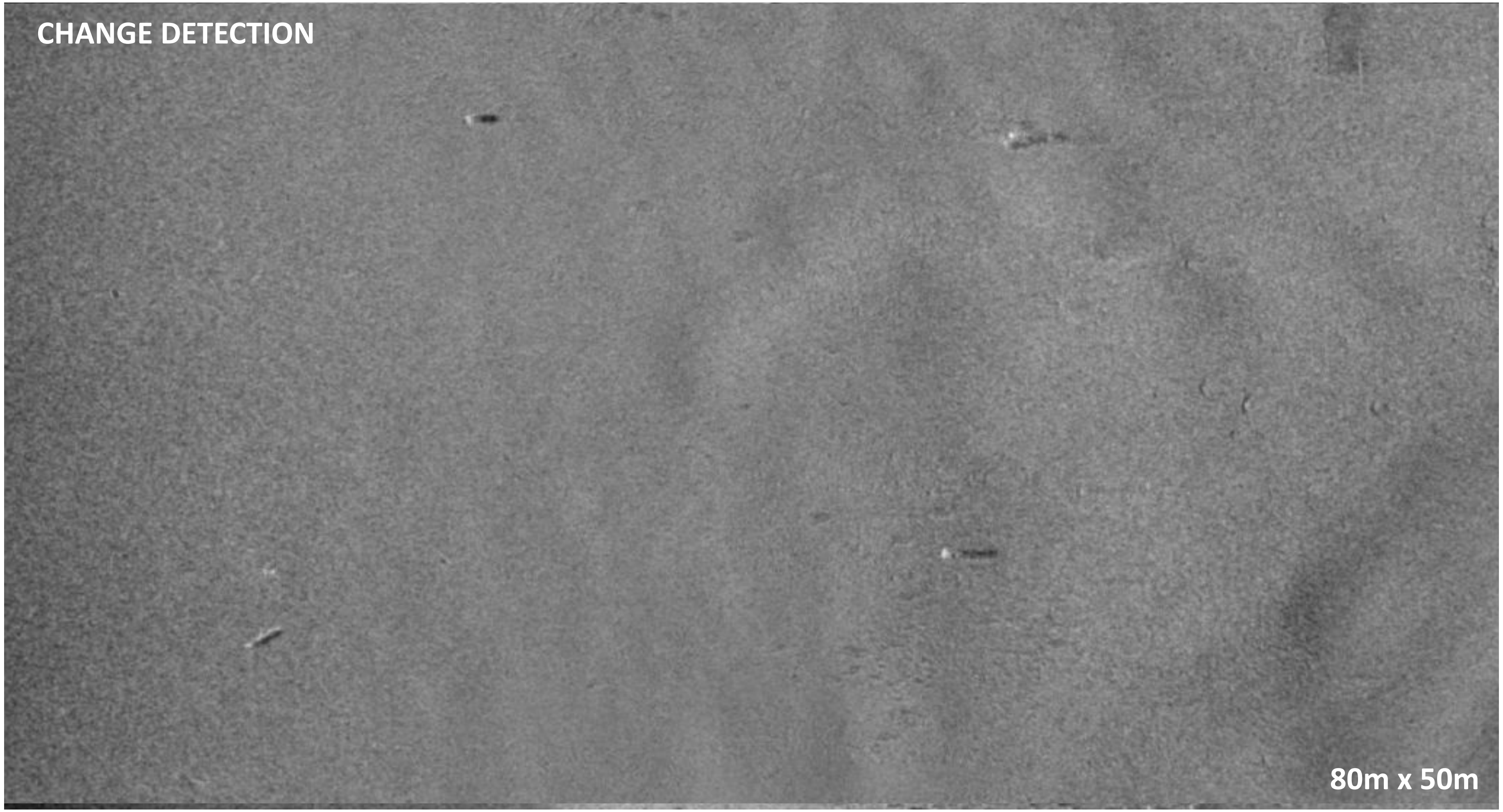
Future Work



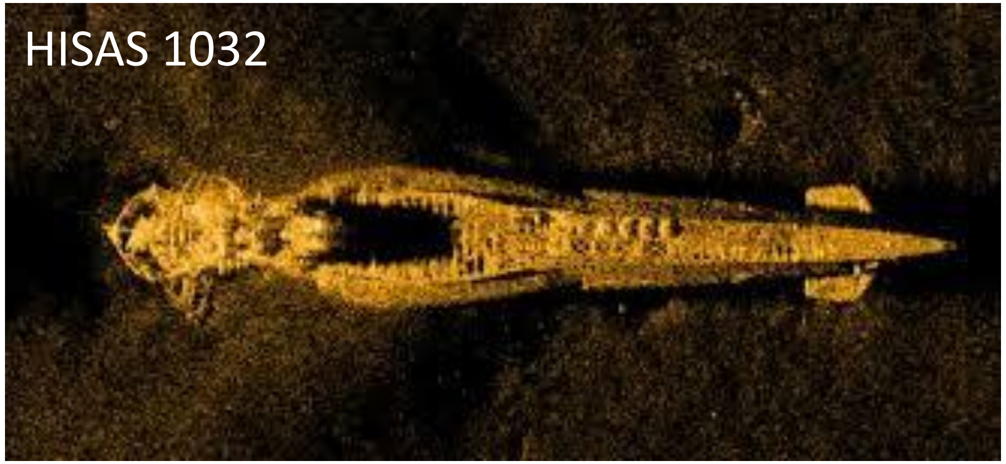
Developing Actionable Information

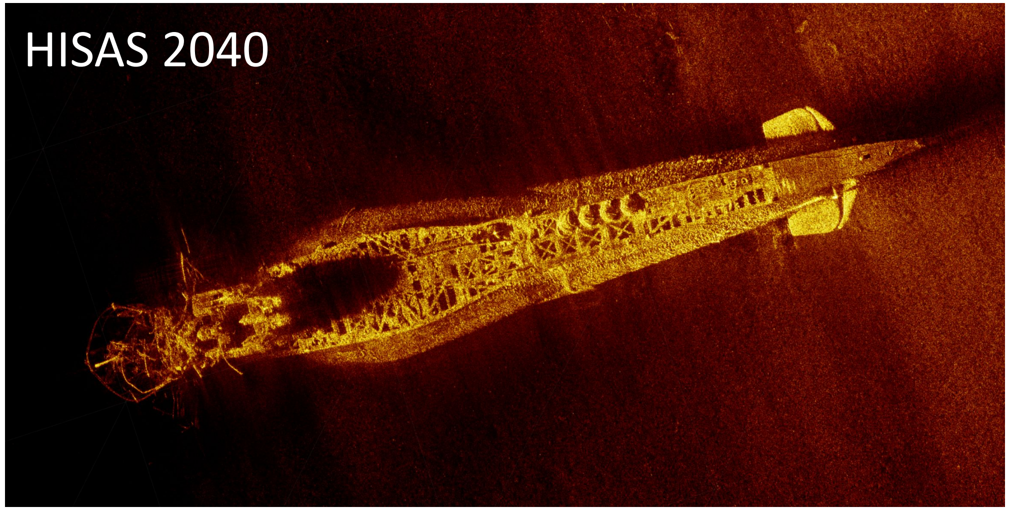


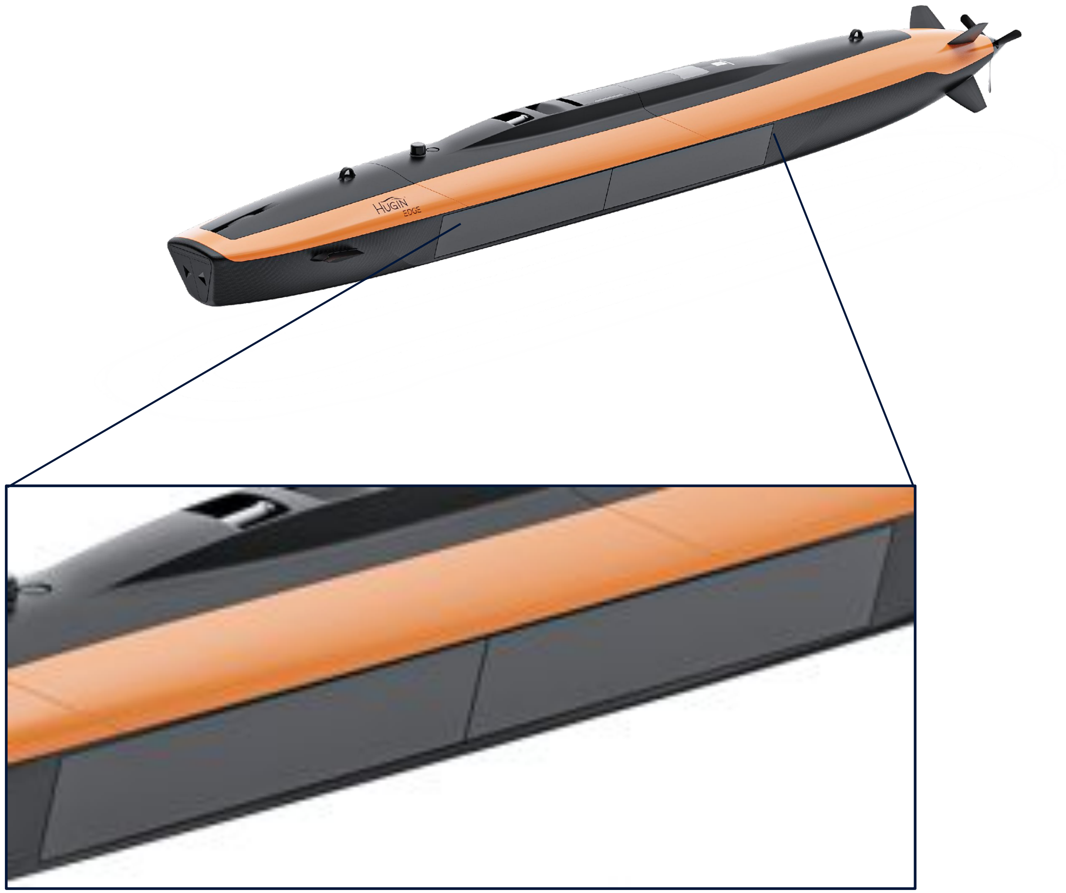
Automated Change Detection



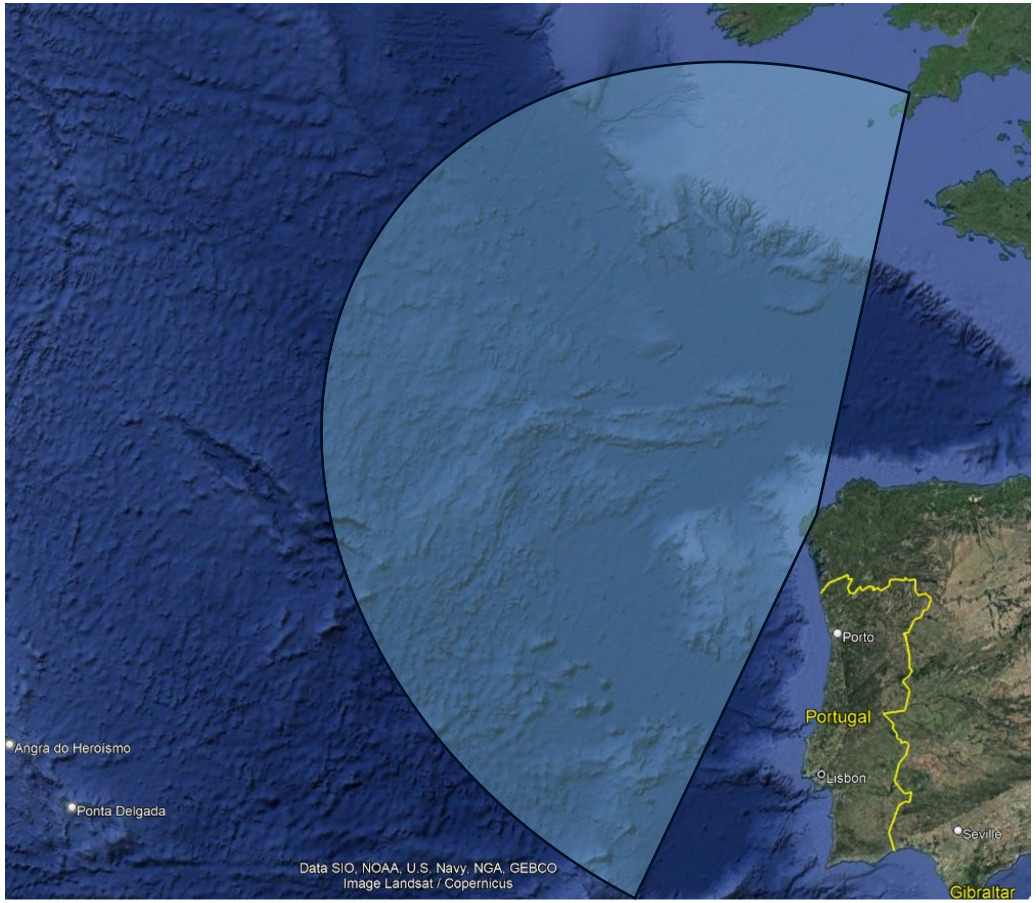
Even Higher Resolution



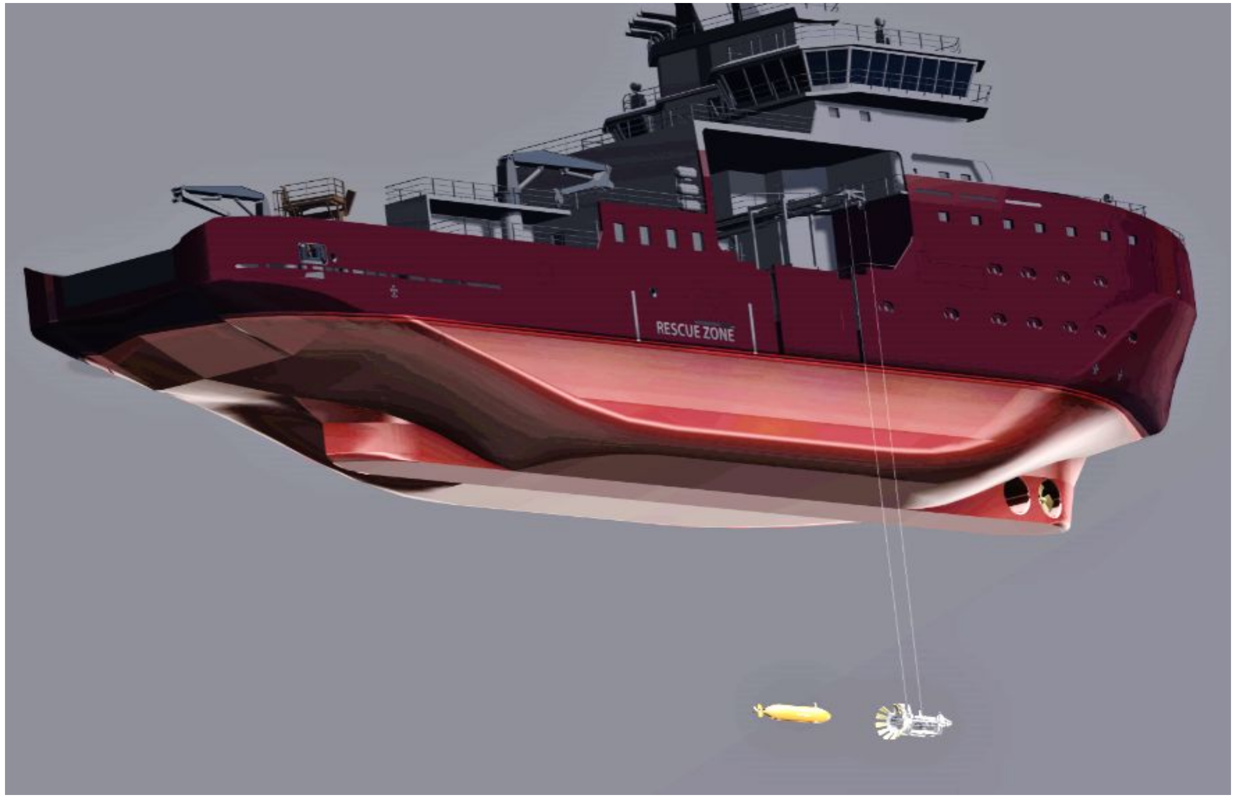


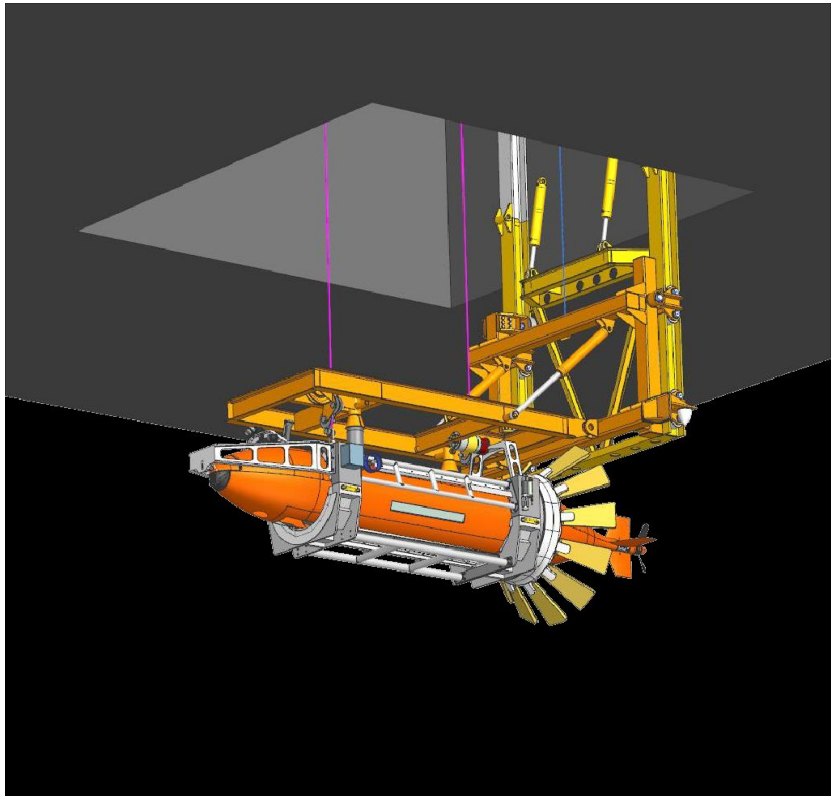


Long Range Shore to Shore Operations



Sub-Surface L/R





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Encouraging the Use of MUS

1. Impediments to large scale use of MUS
    - Trust in the systems
    - Lack of comprehensive international regulations

2. What can Defence do to accelerate the operational exploitation of MUS?
    - Large scale experimentation in controlled conditions
    - Greater use of readily available commercial systems
    - Help drive the regulatory issue
    - Evolve workforce to specifically address MUS

3. What can Industry do to increase the operational maturity MUS?
    - Forge collaborative partnerships with defence counterparts
    - Embrace interoperability requirements
    - Participate in naval exercises where possible
    - Help drive the regulatory issue

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Thank you

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