

The background of the slide is a composite image. At the top, a satellite in space is shown with a white beam of light projecting down to a large, colorful bathymetric map of a seafloor. The map uses a color gradient from blue (deep) to red (shallow). In the upper right corner, a small white aircraft is flying. In the middle ground, a large red Fugro survey ship is on the left, and a smaller red tugboat is on the right. The sea is dark blue. The Fugro logo, consisting of a stylized 'f' followed by 'UGRO' in a bold, sans-serif font, is positioned in the top right corner.

FUGRO

# USVs and Communication

## Or how to breathe through a straw

Igor Dorrestijn, September 7<sup>th</sup> 2023



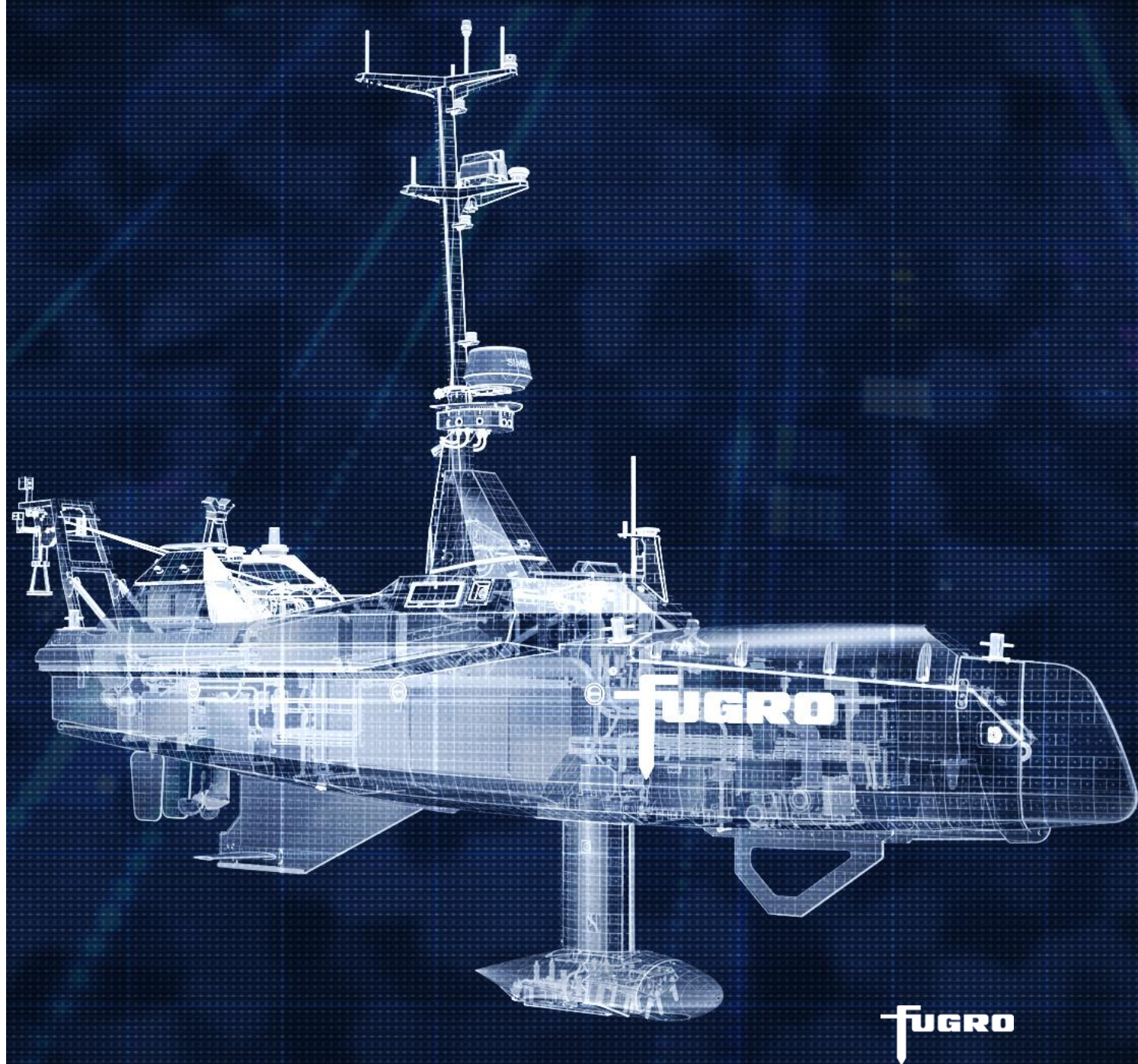
# Fugro USV Solutions





# Introducing Blue Shadow

- Hydrographic USV
- Intended as a force multiplier
- Nearshore capable

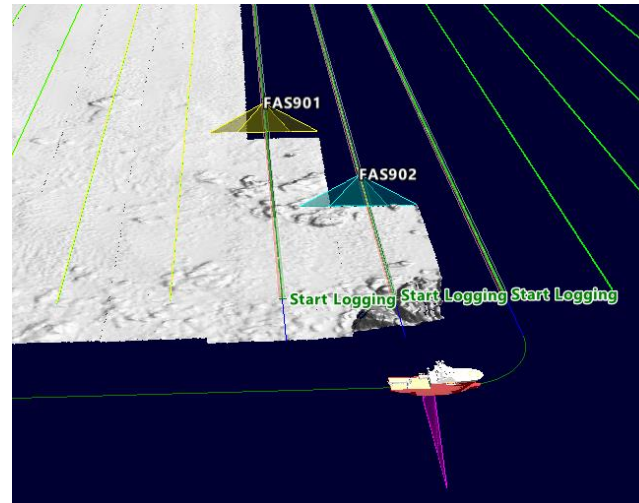


# Survey operations



## Mobilisation

- Designed to fit into a standard 40' ISO container
- Enables simple and efficient mobilisation worldwide



## Operating scenarios

- Force multiplier with parent vessel simultaneous operations
- Data is processed and transmitted for real time monitoring
- Wave piercing hull design for up to sea state 4 workability

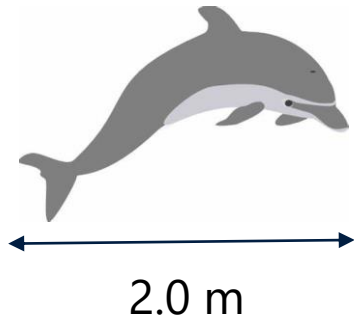


## Launch and recovery

- Floating launch and recovery system
- Designed to drive vessel into dock
- Connected onto storage cradle onboard vessel

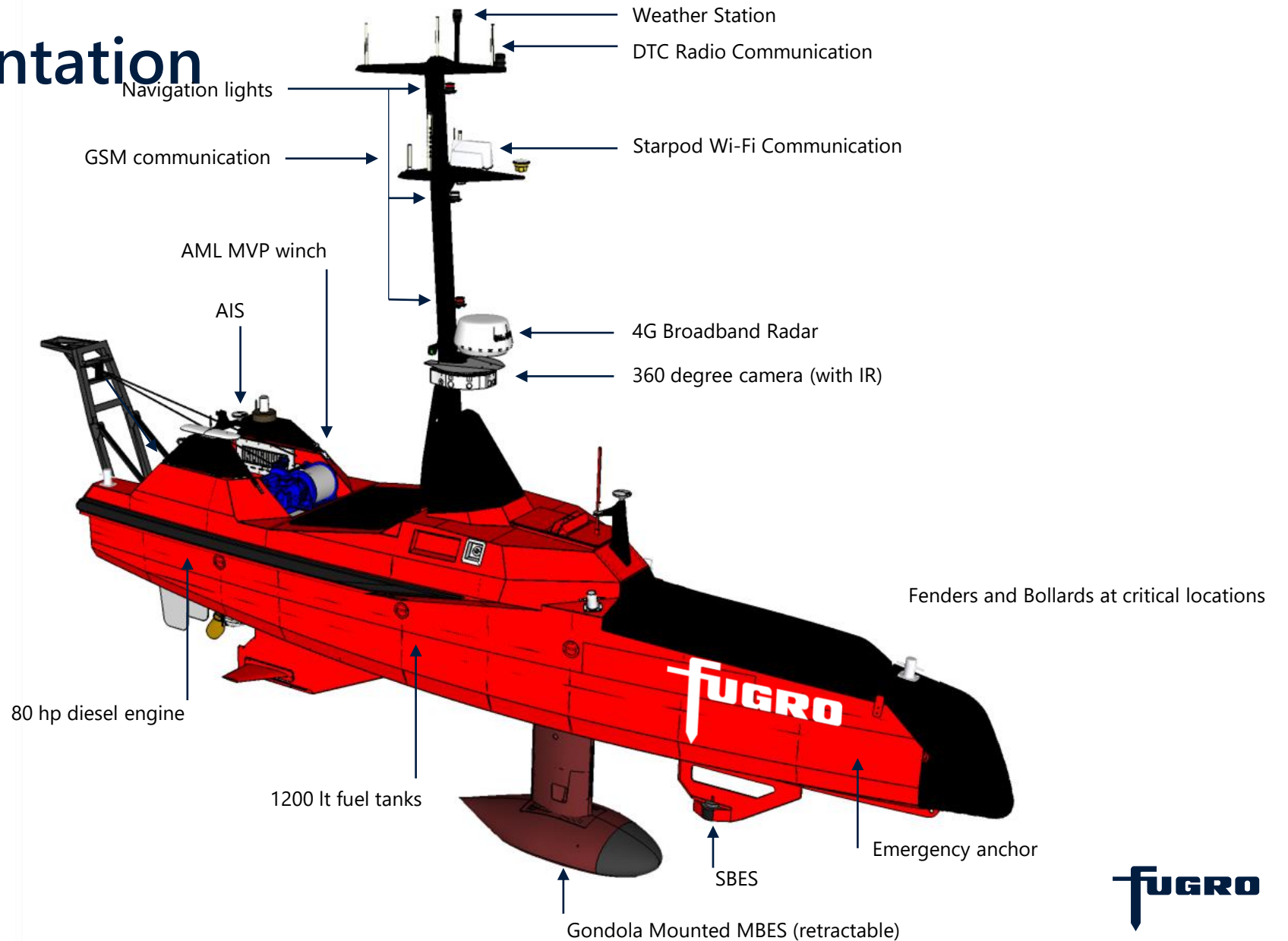


# Vessel instrumentation



## Statistics

|          |               |
|----------|---------------|
| Length   | 8.85m         |
| Beam     | 1.77m         |
| Draft    | 1.21m / 2.00m |
| Weight   | 5450 kg       |
| Duration | 7-10 days     |



# Blue Shadow Comms Links

Digital radio links to support vessel:

- DTC and/or MBR digital radios
- Starpod extended WiFi link

Backup link near shore and some offshore locations:

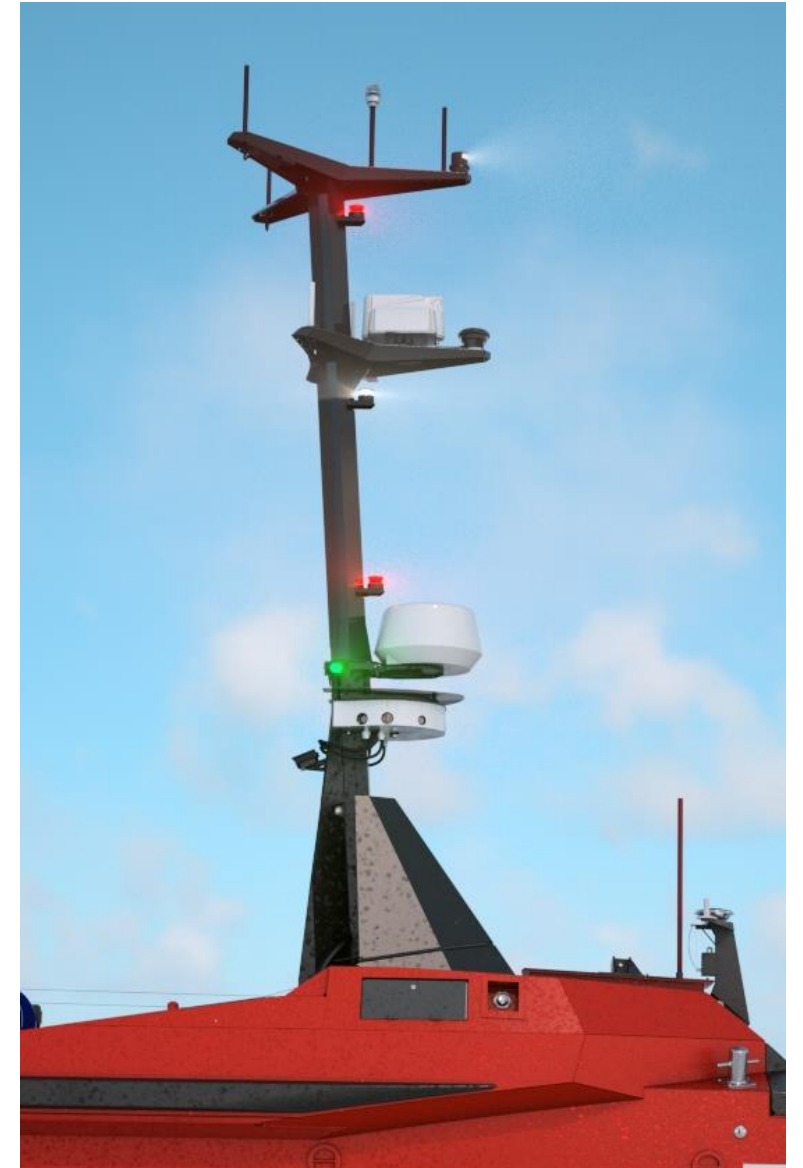
- 4G network

Under development for over the horizon communication:

- Starlink terminal

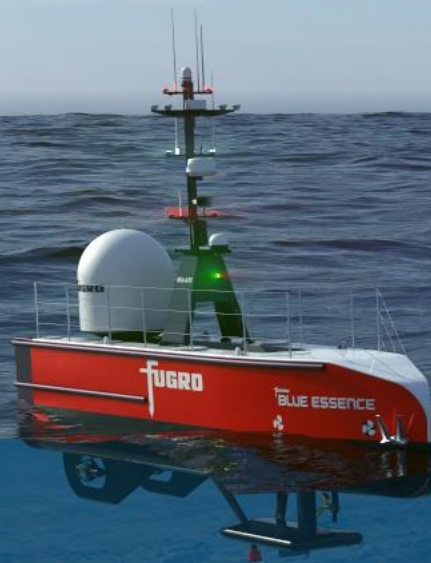
Main bandwidth consumers:

- Hydrographic data
- Vessel navigation cameras





# ROV USVs



Multibeam /  
Sub bottom imager



Multibeam /  
Sub bottom imager



Multibeam



MBES/Pipetracker/magnetometer

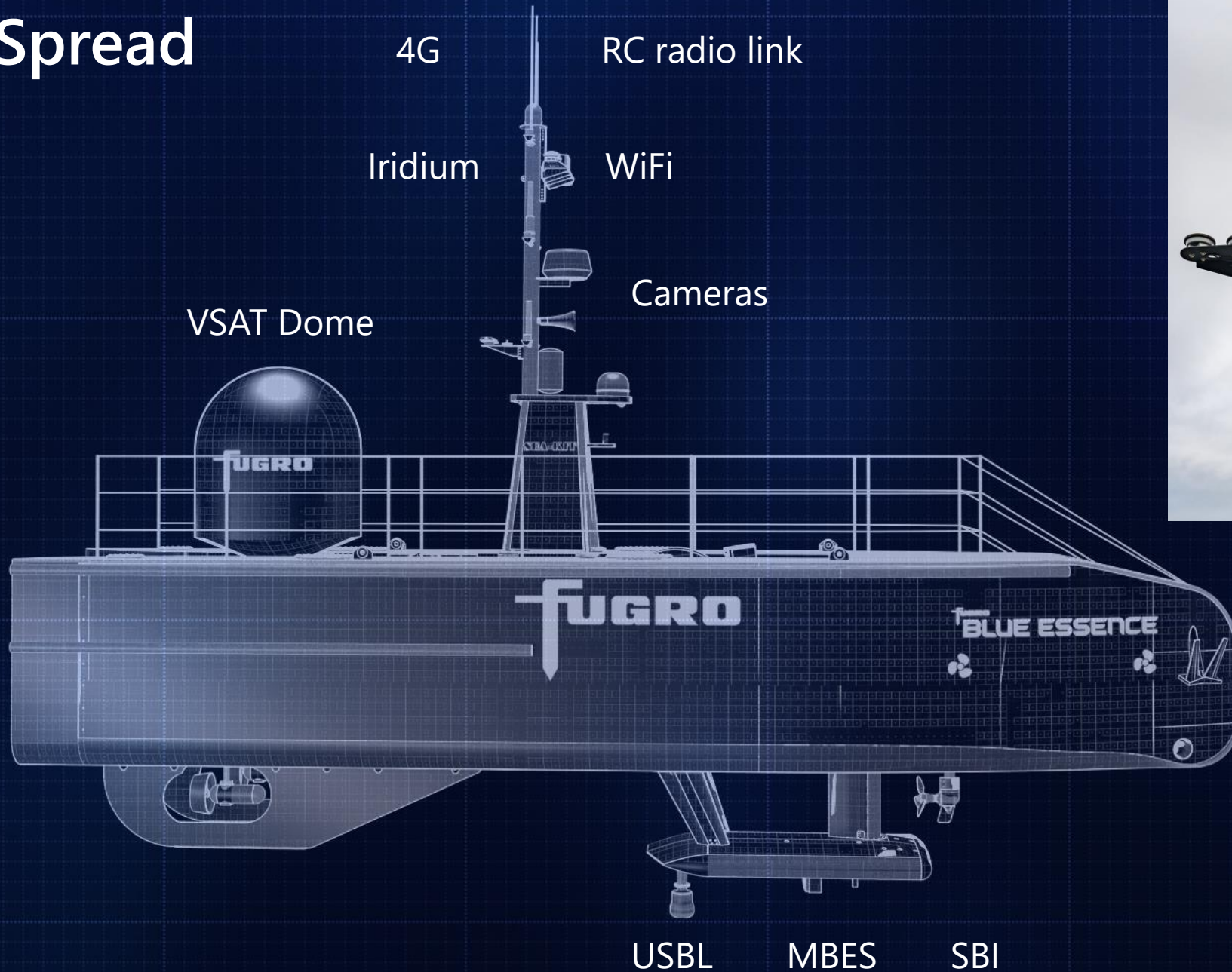


## 12m Blue Essence series





# Sensor Spread



# VSAT Link

The only over-the-horizon guaranteed bandwidth link

Bandwidth is region dependent

Tracking in high sea state is a problem





# Bandwidth Sharing

Transit and vessel only work:

- Vessel navigation cameras on high quality
- Multibeam data

ROV work:

- Reduced number of vessel cameras and quality
- High quality video feed of pilot camera
- Low quality other ROV cameras
- ROV sensor data

Black box storage of high quality feeds on the vessel



# Fallback Options

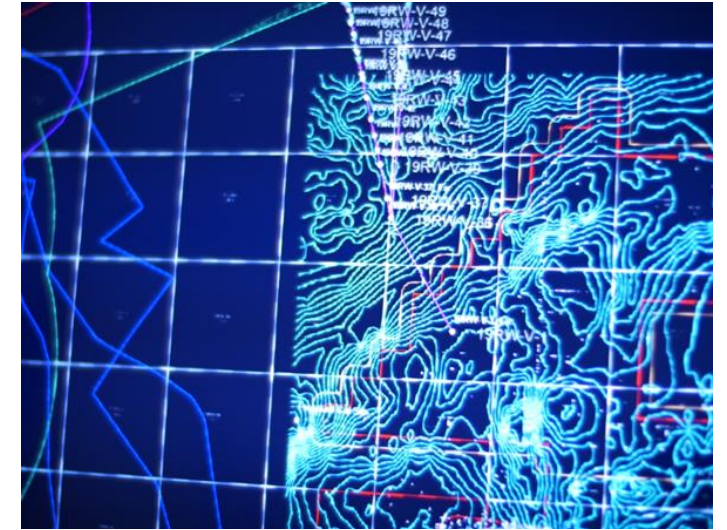
| Link           | Control                     | Cameras and sensors           |
|----------------|-----------------------------|-------------------------------|
| VSAT           | Full vessel and ROV control | Full bandwidth spread         |
| 4G             | Full vessel and ROV control | Reduced, depending on network |
| Iridium        | Sparse control set          | Single low bitrate stream     |
| Remote control | Vessel maneuvering only     | n.a.                          |
| Support vessel | Tow line                    |                               |





# Remote Operations Challenges

- Bandwidth limitation
- Latency
- Loss of link
- Routing issues
- Loss of ROC
- ROC handover





# The New Normal

Operations at a fraction of the emission levels made possible by reliable communication links







FUGRO

FUGRO

SEA-KIT

THALES

THALES

SIMUL

458581

2M

6

3M

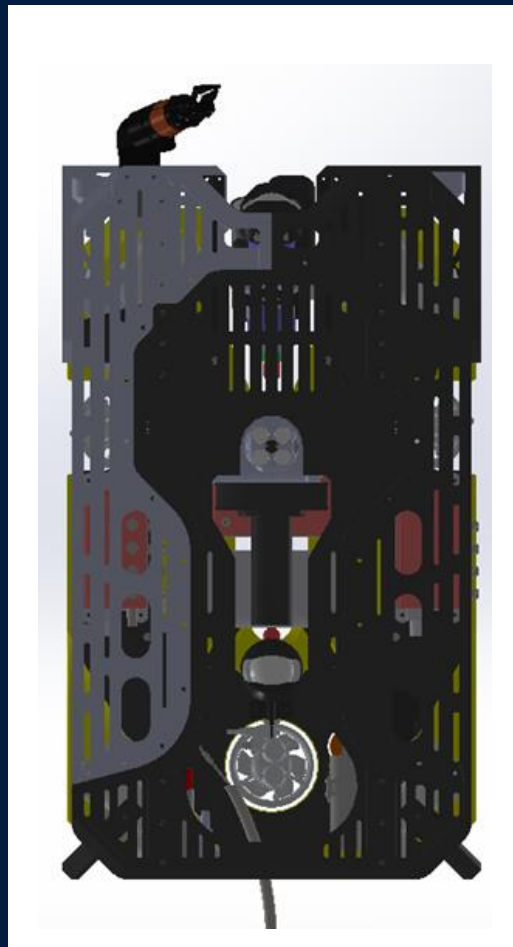
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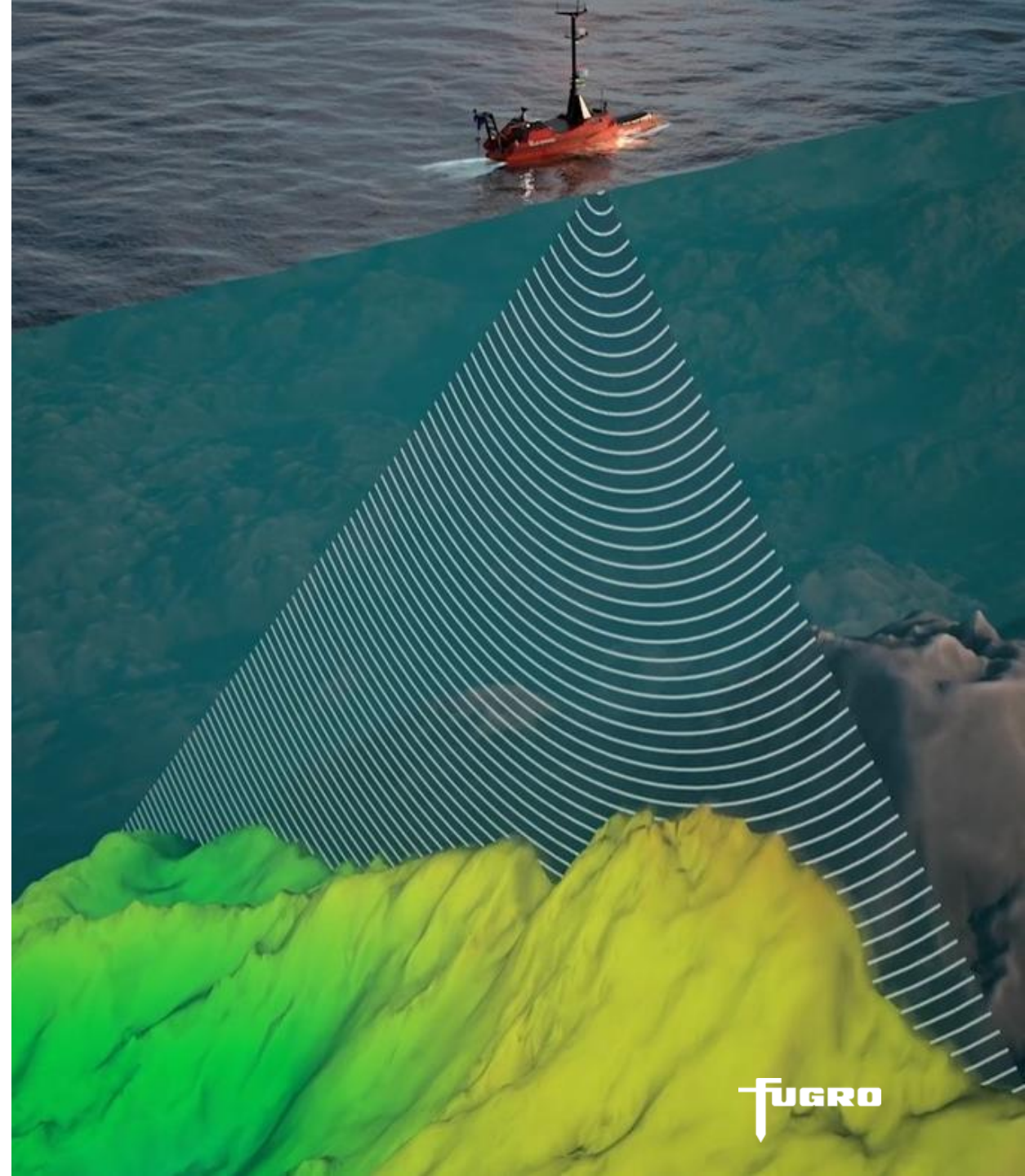
# Blue Volta





# Survey equipment

| Survey equipment               |   |
|--------------------------------|---|
| Multi beam echo sounder (MBES) | Kongsberg EM2040 Mk II (Dual Head)  |
| Echo sounder (SBES)            | Teledyne Echotrack E20  |
| Positioning                    | GNSS with Fugro G2+/G4  |
| Motion reference unit          | Kongsberg MGC-R3 (within Kongsberg Seapath 380-R3)  |
| Sound velocity profiler        | AML MVP-X CTD (on AML MVP30-350 winch)  |
| Sound velocity (@ head)        | Valeport UV-SVP   |
| Navigation package             | Fugro Starfix Suite   |
| Communications                 | <ul style="list-style-type: none"><li>▪ DTC COFDM Radio (6-8 km, LOS)</li><li>▪ Wi-Fi (2-4 km LOS)</li><li>▪ 4G</li></ul> |



# Key features



Dynamic line planning  
and force multiplier  
capability



Uncrewed and  
autonomous  
operations



Remote operation  
managed from  
parent vessel



Advanced situational  
awareness and  
collision avoidance





# Questions?

