



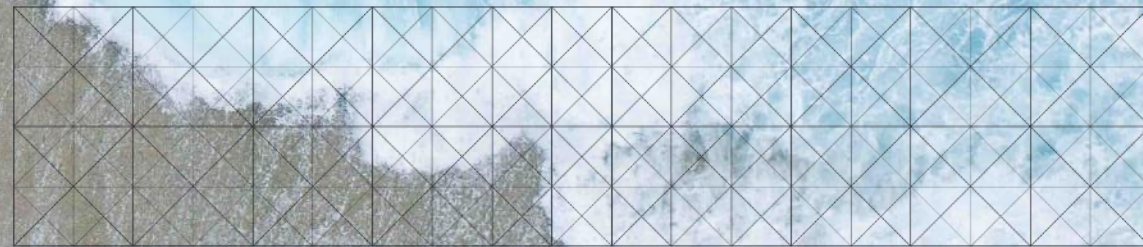
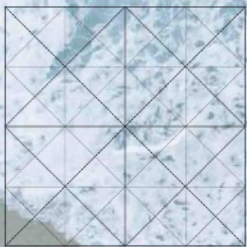
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2018

# Kongsberg Maritime Remote Survey Capabilities

10/01/2019

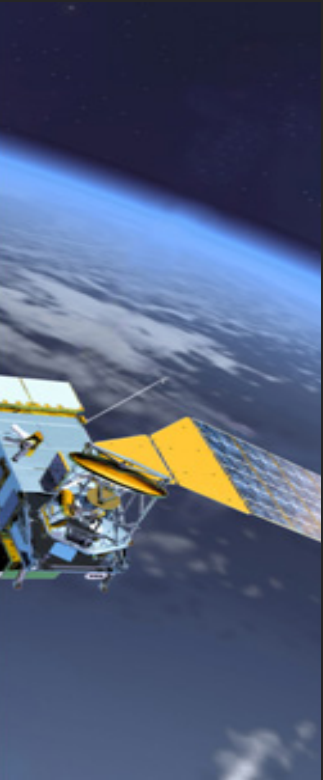
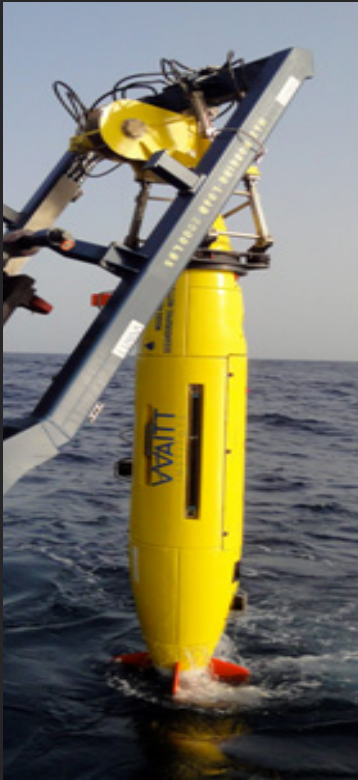
Dr Martin Gutowski  
Regional Sales Director Subsea  
Richard Mills  
Director Marine Robotics Sales



# Kongsberg Group 200 Years of Innovation

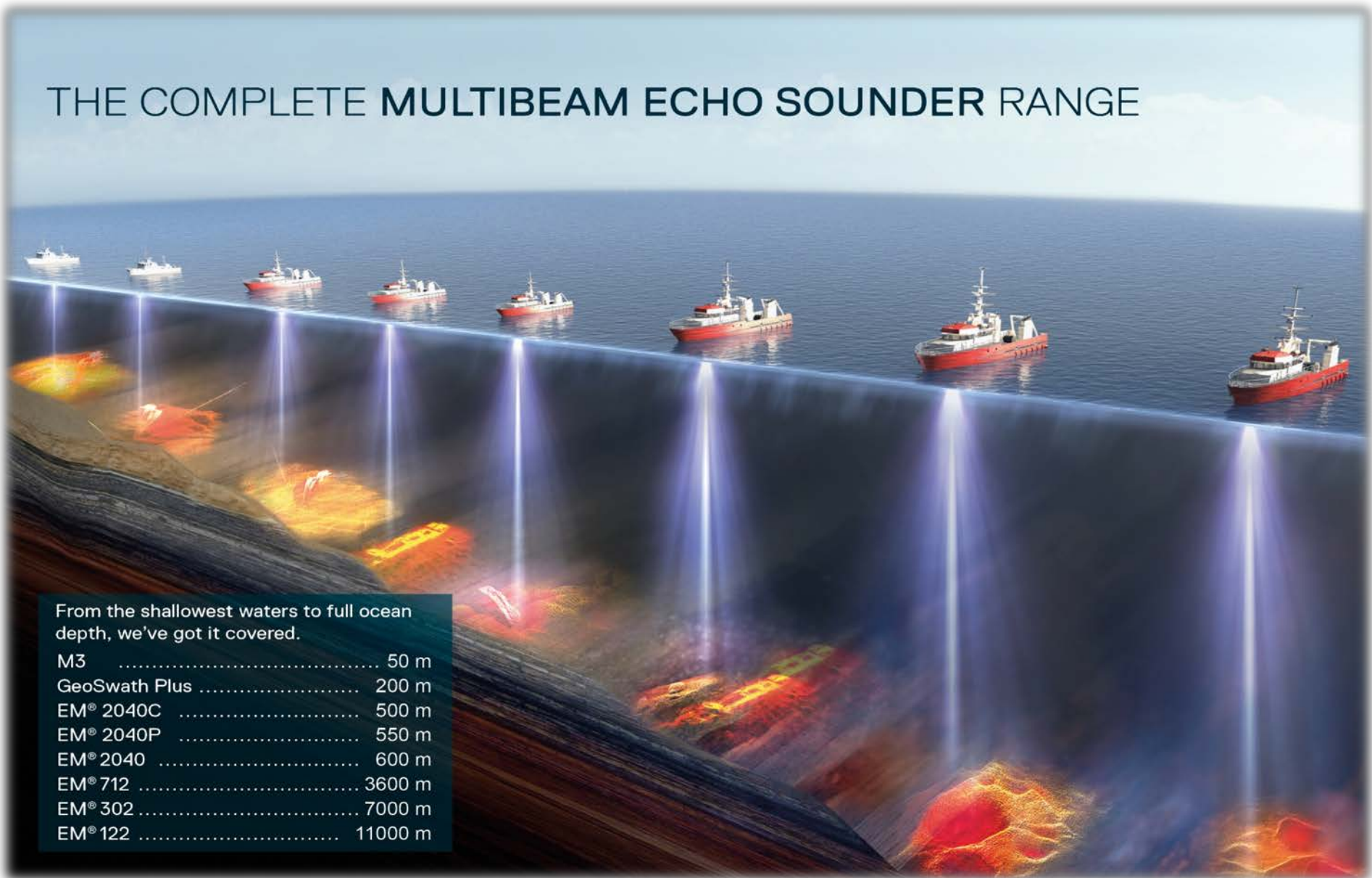


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From Deep Sea to Outer Space

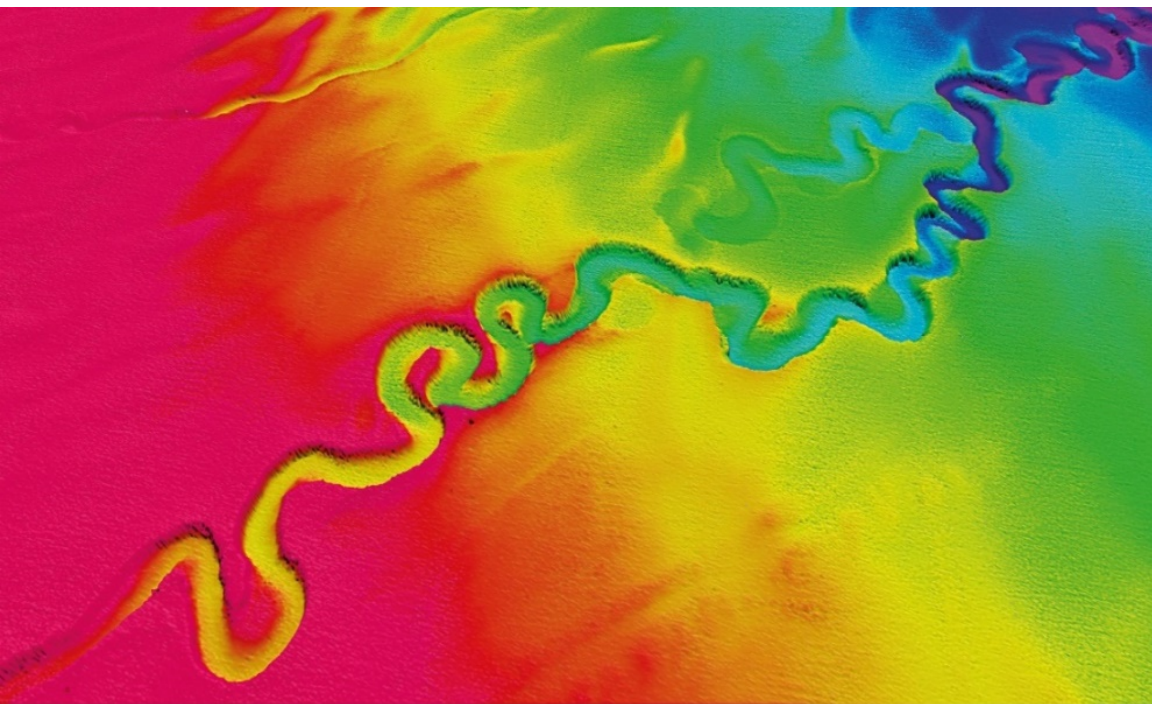
# THE COMPLETE MULTIBEAM ECHO SOUNDER RANGE



From the shallowest waters to full ocean depth, we've got it covered.

M3	50 m
GeoSwath Plus	200 m
EM® 2040C	500 m
EM® 2040P	550 m
EM® 2040	600 m
EM® 712	3600 m
EM® 302	7000 m
EM® 122	11000 m

# EM 304



Deep Sea Channels, depth 2100m, EM 302 2X2. Courtesy of IOLR

## Higher number of beams for denser sounding pattern on seabed

- >1600 individual beams; maintained and automatically adjusted according to achievable coverage or operator defined limits
- 1600 for a 0.5 and 1 degree RX
- 1024 for a 2 degree RX
- 512 for a 4 degree RX (dual swath mode)

## Full ensonification of the seabed

- 16 individual sector in dual swath mode, 8 sectors per swath
- Active real-time, stabilization of the transmit fan correcting for any yaw and pitch movement
- Roll stabilization applied on receiving beams

# EM 124

Long range	
Nominal frequency	12kHz
Frequency sweep	10.5 – 13.5 kHz
Range	20-11.000m, or full ocean depth
Max swath width	40 km 6x water depth 140 degrees coverage
Pulse length	1 ms CW to 100 ms FM effective pulse length
Ping rate	Maximum 10 Hz Limited by the round trip travel time in the water
Range sample rate	3.25 kHz (23 cm)

### Higher number of beams for denser sounding pattern on seabed

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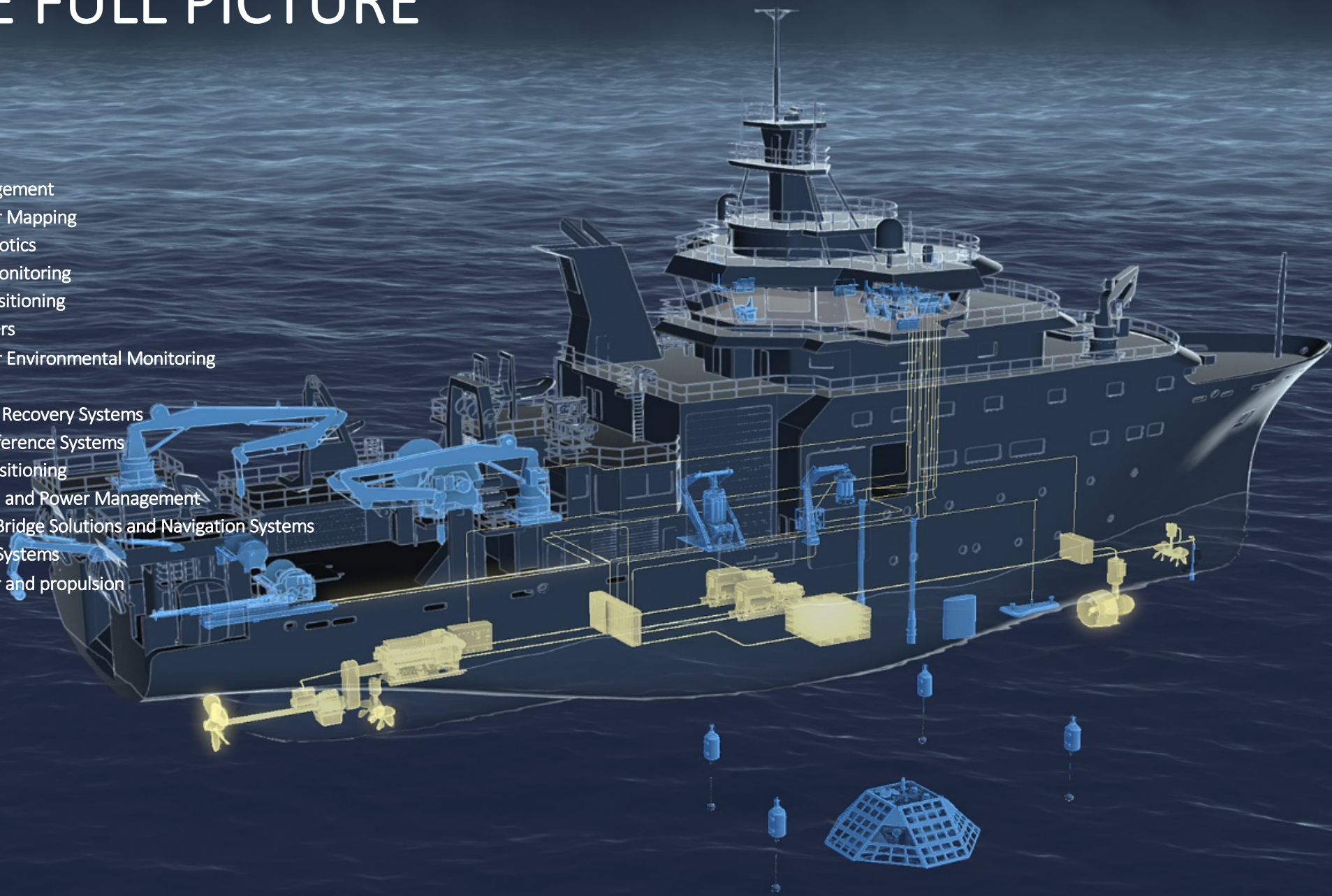
# EM 2040P MKII



# THE FULL PICTURE



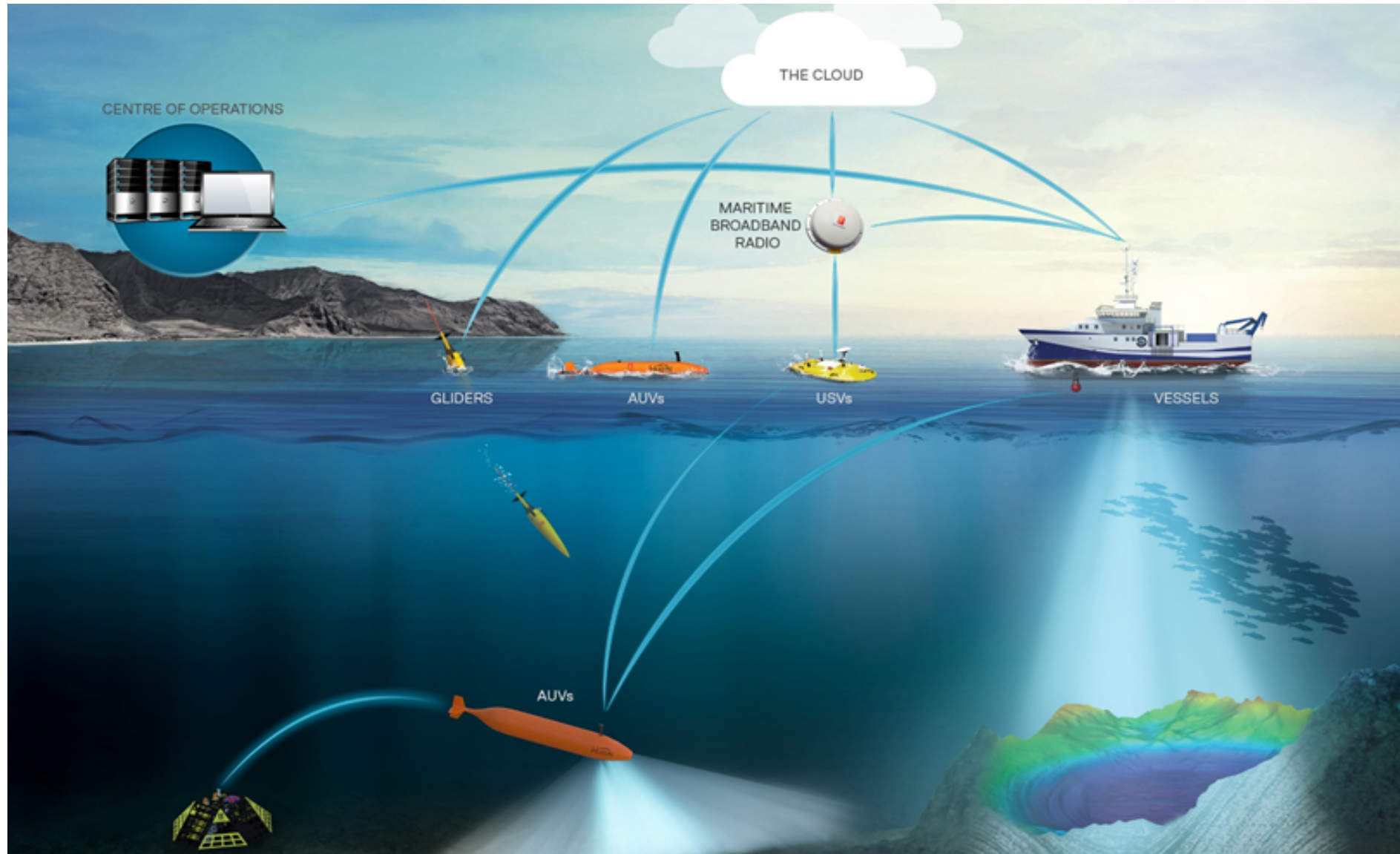
- Data Management
- Underwater Mapping
- Marine Robotics
- Scientific Monitoring
- Acoustic Positioning
- Transponders
- Underwater Environmental Monitoring
- Camera
- Launch and Recovery Systems
- Position Reference Systems
- Dynamic Positioning
- Automation and Power Management
- Integrated Bridge Solutions and Navigation Systems
- Simulation Systems
- **NEW** power and propulsion





# Best quality data

Collected in the most cost effective manner







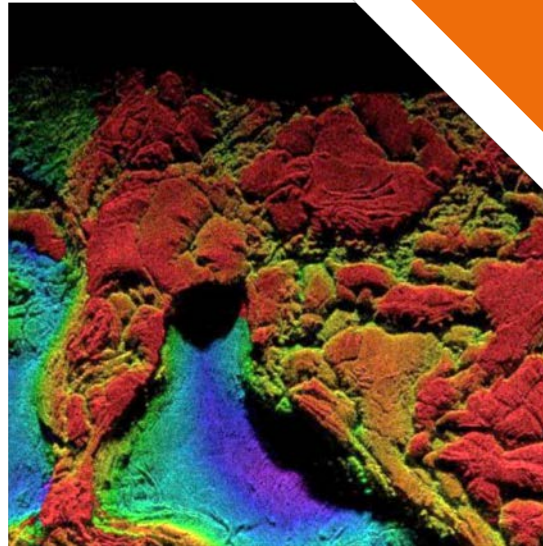
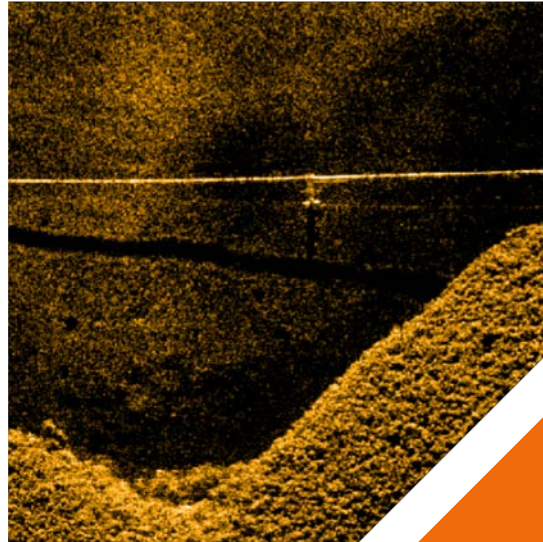
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# Kongsberg Maritime Marine Robotics



# Kongsberg Maritime Marine Robotics

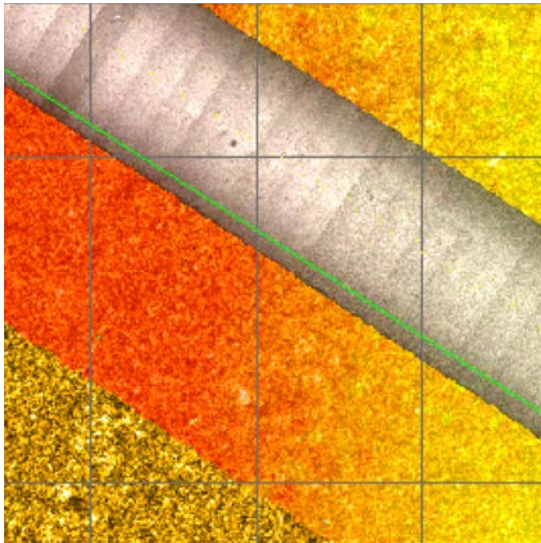
We collect high value data and provide reliable processing tools to make a cohesive and accessible data set.



It's all about the data, from collection to reporting

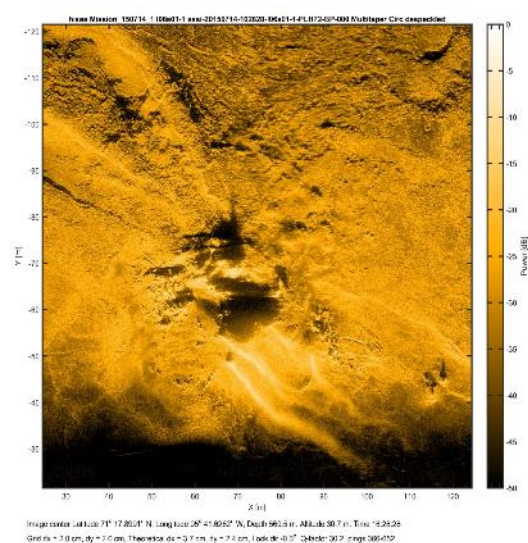
# Marine Robotics System Applications

Our platforms are capable of multi-role operations designed to work in commercial, scientific, governmental and defence applications



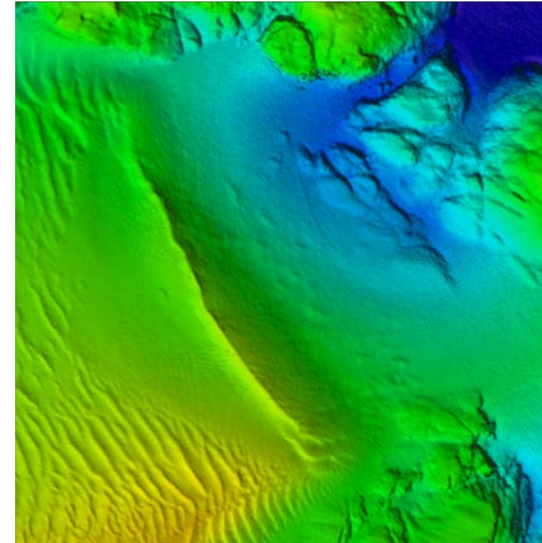
## COMMERCIAL

Geophysical survey, site characterisation, route selection, pipeline survey and inspection etc.



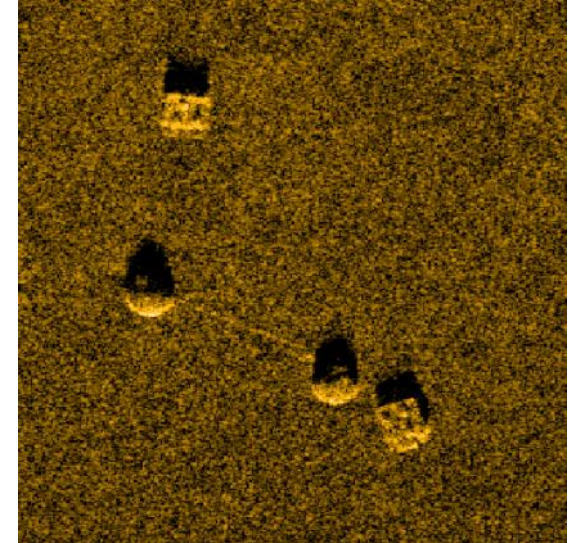
## SCIENTIFIC

Environmental assessment, marine archaeology, sediment and scour survey, mineral exploration etc.



## GOVERNMENTAL

Hydrography, search and rescue, environmental impact studies, pre-license exploration etc.



## DEFENCE

Rapid environmental assessment, mine countermeasures, hydrography, anti-submarine warfare etc.



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Supporting the  
NF-GEBCO Alumni  
Team

Shell  
OCEAN DISCOVERY XPRIZE®

# DISCOVERING THE MYSTERIES OF THE DEEP SEA

PHASE Testing & Certification

# Kongsberg Autonomy Enabling the System

The USV and HUGIN AUV share some common capabilities derived from Kongsberg Maritime's autonomy developments.



The SEA-KIT USV control is provided by K-MATE with KM scene analysis, mission control and data handling

# USV Systems and Sensors

The USV is equipped with many other Kongsberg Maritime Systems and Sensors



**MBR**



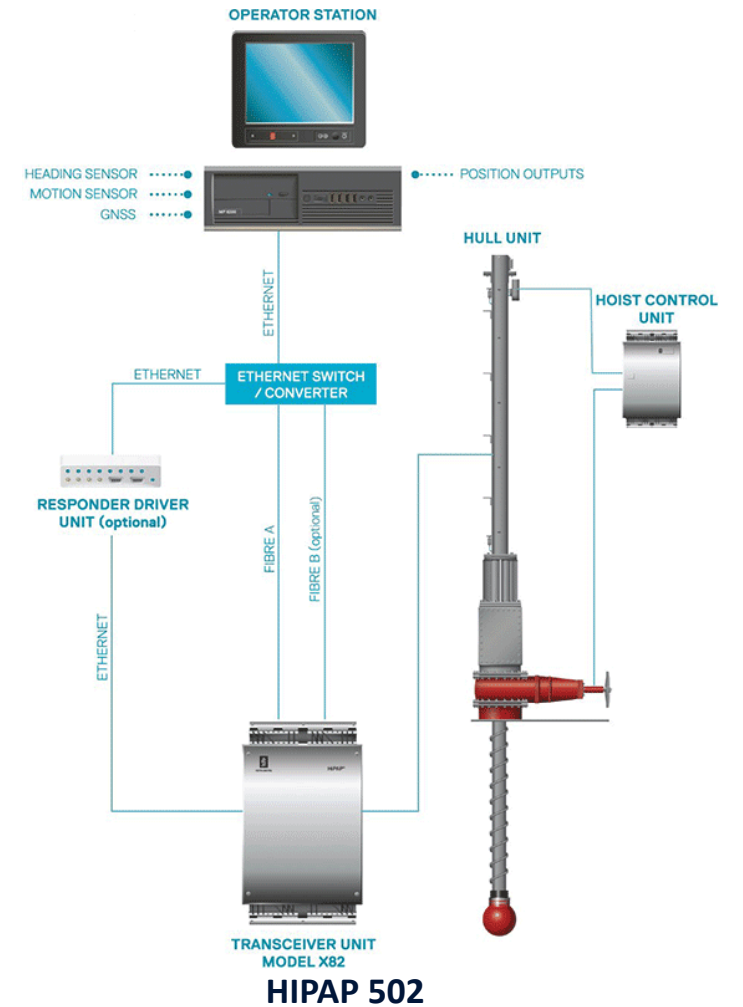
**SEAPATH 330**



**AIS 300**



**MGC-R3**



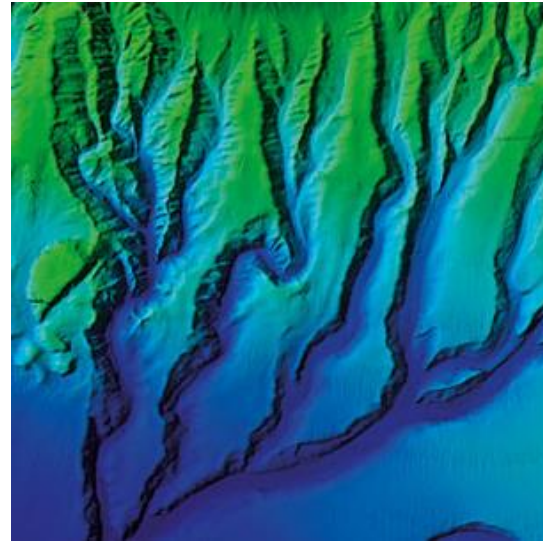
# Progress Towards Round 2

Kongsberg Maritime has provided equipment, development, personnel and testing facilities to the Nippon Foundation-GEBCO Alumni team



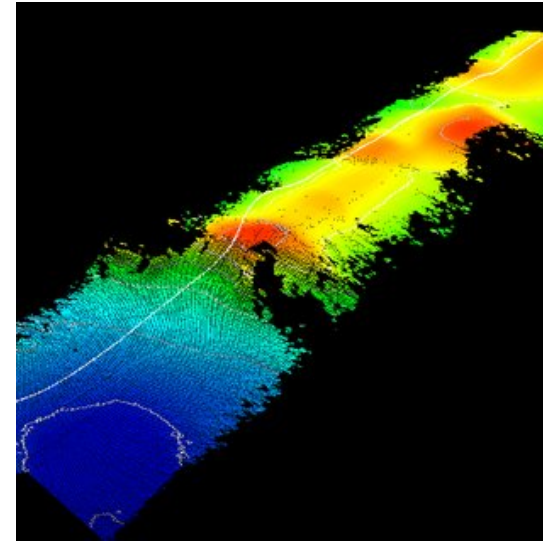
**HUGIN AUV**

Access to a HUGIN for trials and testing plus for the competition phase, either heavily discounted or free



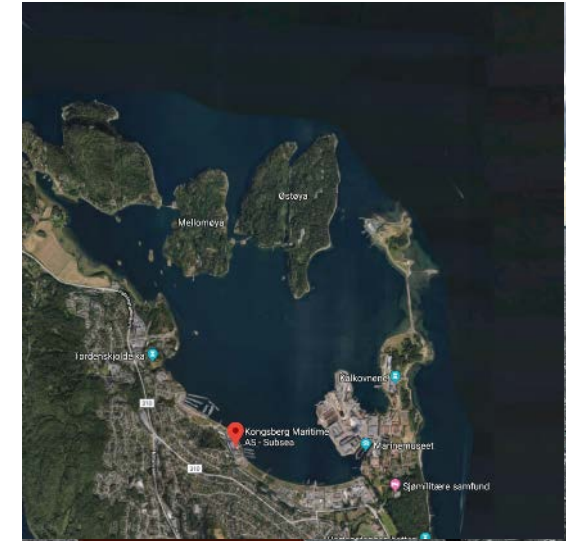
**EM304**

USV mounted multibeam echosounder for trials, testing and the competition phase with Mapping Cloud to access data rapidly on-shore




**DEVELOPMENT**

Custom bathymetry algorithms created for the HISAS on board the HUGIN AUV to generate bathymetry over a much wider swath



**TRIALS AND EVALUATION**

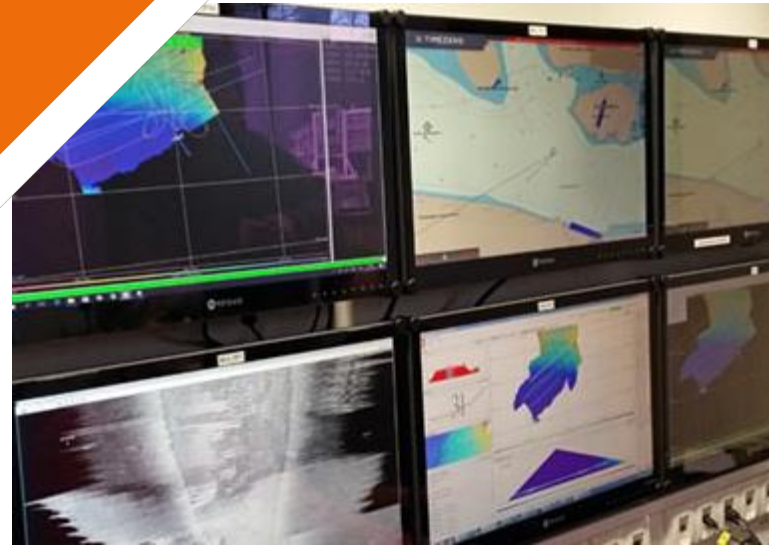
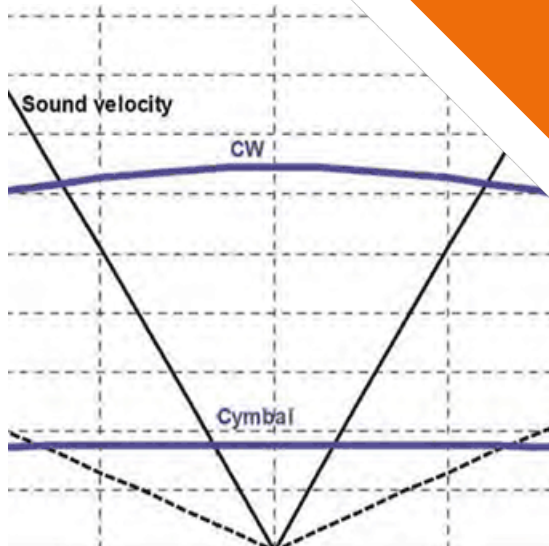
Free access to trials and evaluation facilities and personnel during development phase



Installing the  
equipment is just the  
first part of making it  
work

## Integration, Testing & Optimizing

Kongsberg has provided integration assistance, testing and advice to optimize the performance of the EM304, USV and HUGIN. Overcoming noise on the USV to generate good bathymetry has been a key focus.







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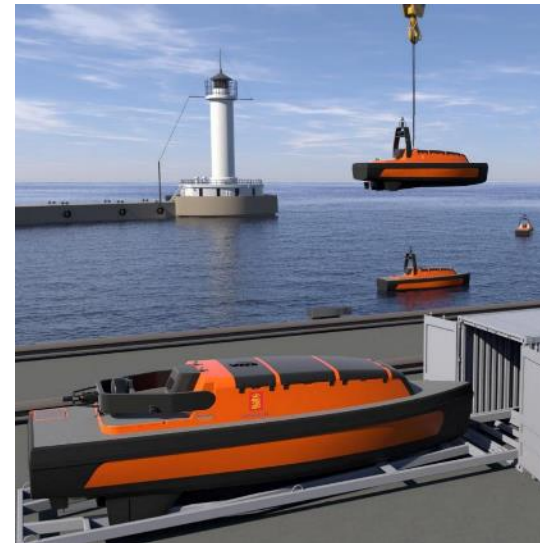
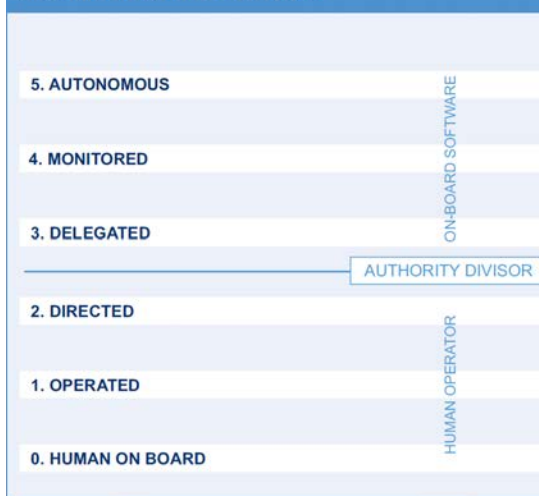
# Unmanned Surface Vehicles



# Unmanned Surface Vehicle

## Deploying Kongsberg Autonomy on Unmanned Surface Vehicles

Figure 2.1: Levels of Control



### K-MATE

K-MATE is the controlling software that enables the safe and efficient autonomous operation of USVs

### DEVELOPMENT

Working in conjunction with FFI (The Norwegian Defence Research Establishment) we have developed advanced autonomy for USV

### SURVEY CLASS

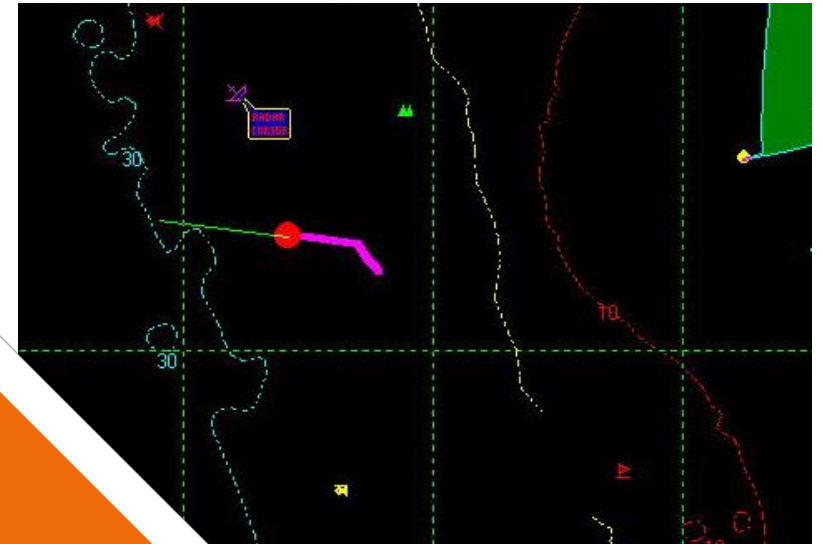
The Norsafe team have designed a USV for shallow water and near-shore use, controlled by K-MATE and equipped with KM sensor packages

### COMBINED SYSTEMS

SEA-KIT has been developed by Hushcraft Ltd, GEBCO and the Nippon Foundation. It is controlled by K-MATE and equipped with KM sensor packages

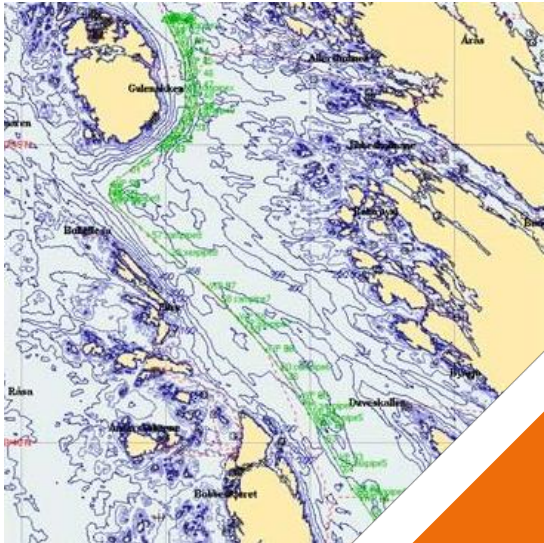
# Advanced Control for USVs

K-MATE includes waypoint and event based mission capabilities combined with advanced control for safe operation.

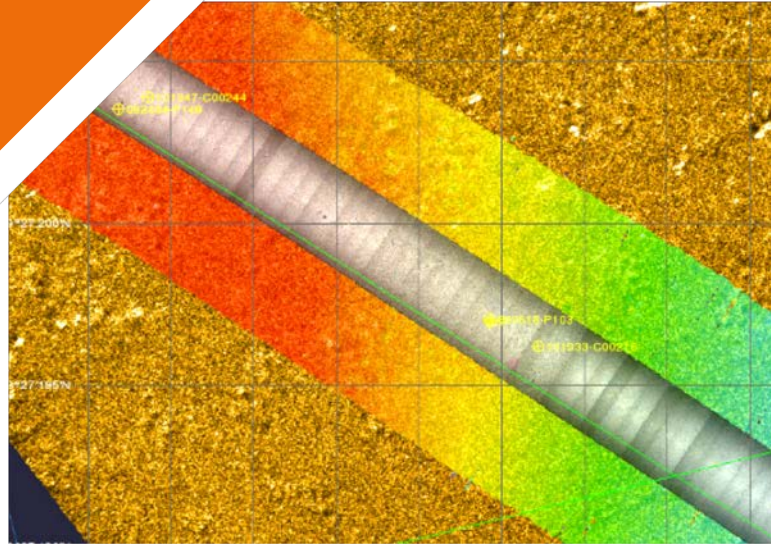
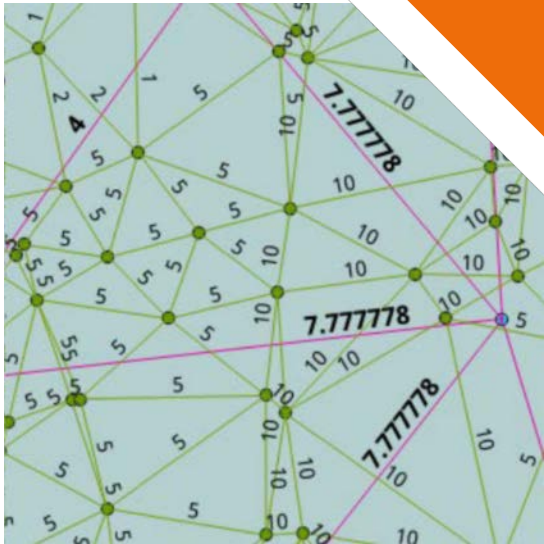


Scene analysis and hazard avoidance



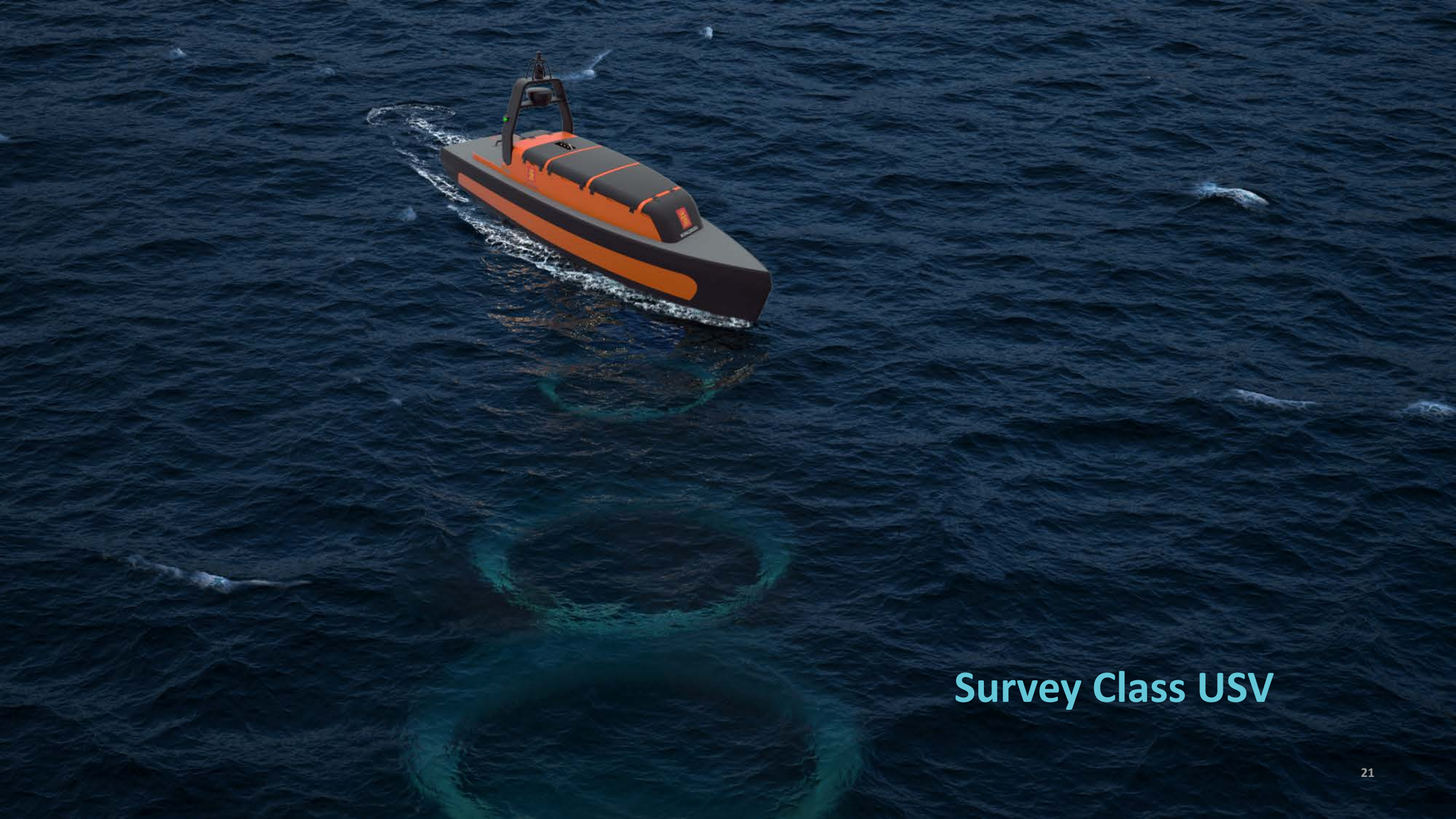


## Goal based mission planning & adaptive control



## Smart Autonomy

HUGIN OS and K-MATE combine event based autonomy with performance based control making the missions data centric.



# Survey Class USV

# Survey Class USV

- Length: 8 m
- Width: 2.2 m
- Speed Range: 0-14 knots
- Endurance: ~10 days @ 7 kts
- Survey: ~6.5 days
- IMU: MGC R3
- INS: Sunstone
- GNSS: Novatel GPS
- Comms: MBR, VHF & Satellite
- AIS: Seatex AIS 300
- Radar: Simrad 4G
- Lidar: Velodyne VLP32C
- Cameras: FLIR M400



## Combined Systems

The SEA-KIT USV is designed to launch and recover the HUGIN AUV making it a true stand-alone force multiplier that can operate remotely.



Launch, supervision and recovery of a HUGIN from a USV





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# Connectivity

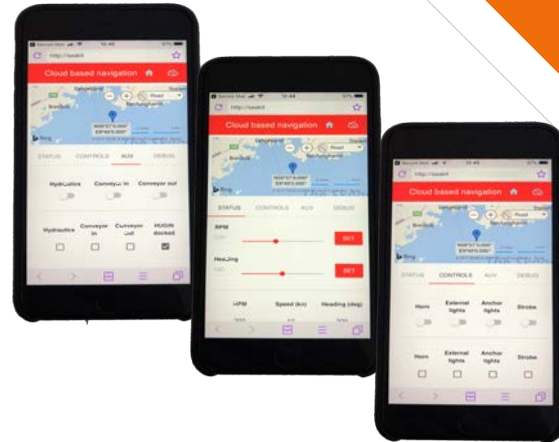




# Connectivity Enabling Remote Operation

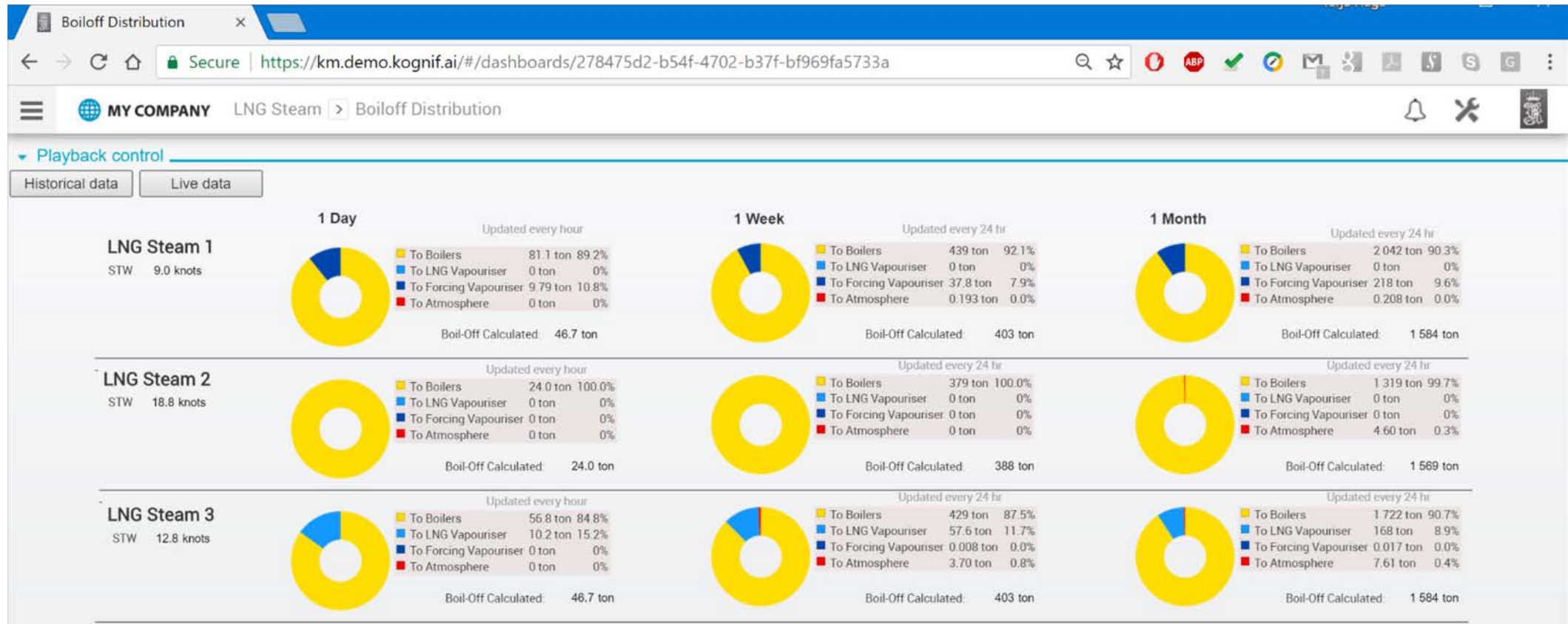
The implementation of digital connectivity through KongnifAI enables mission supervision and data processing from anywhere.

Providing  
remote  
access to  
data



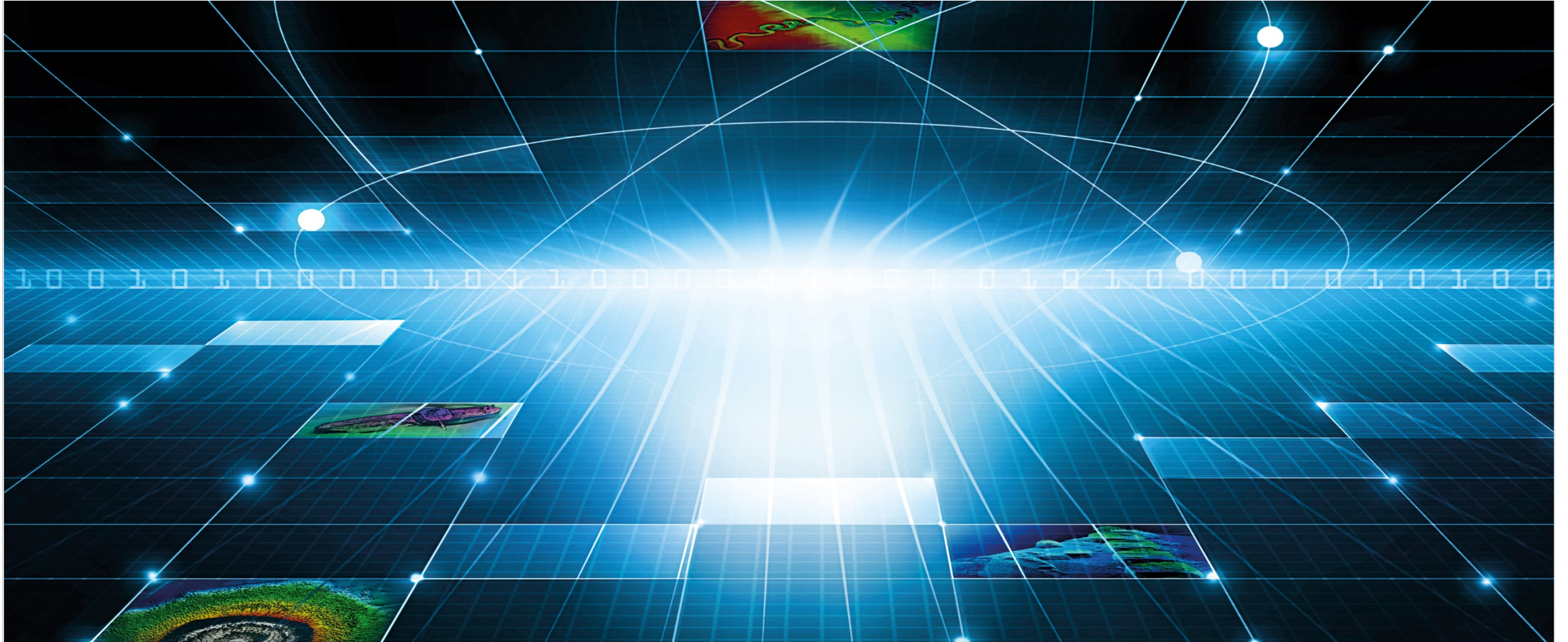
# Kognifai in use

## Vessel & Fleet Management



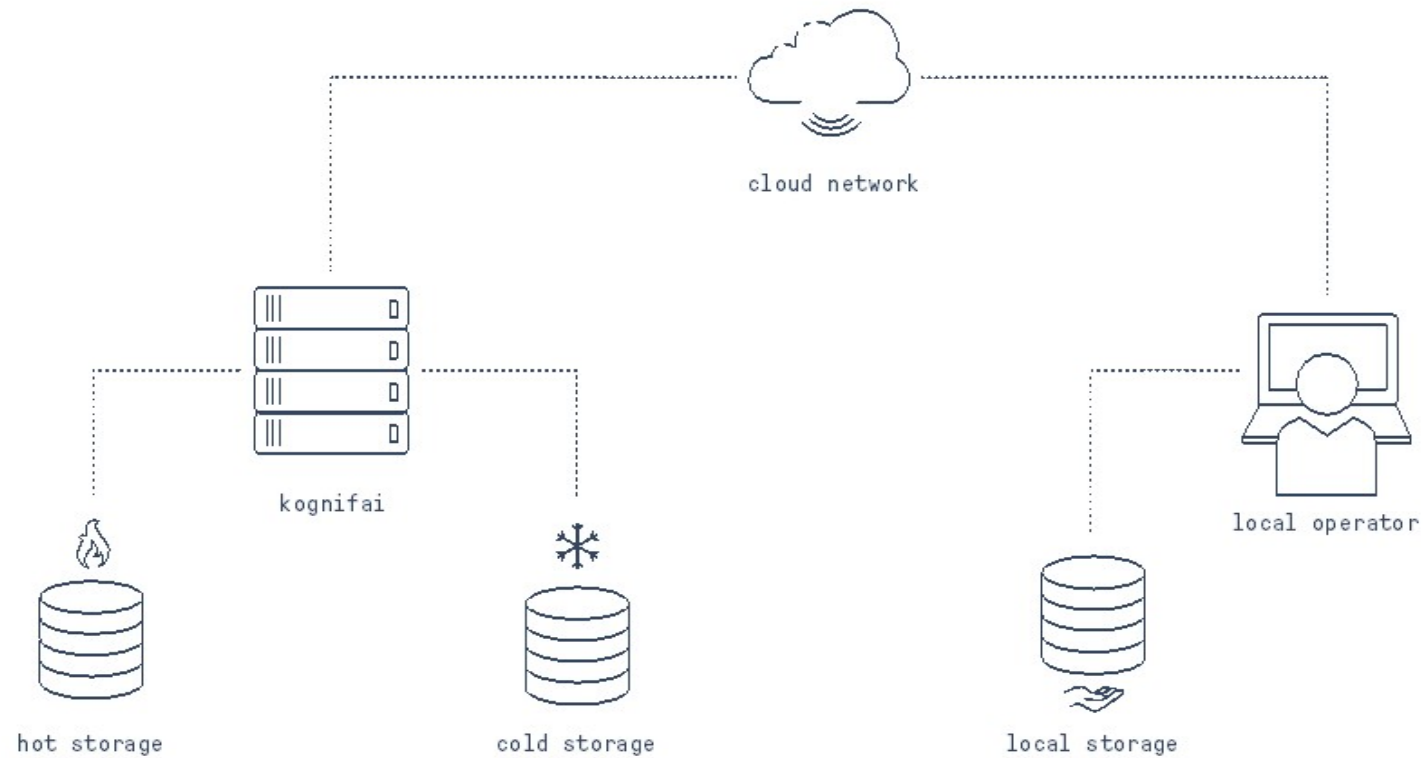
# Mapping Cloud

Visualize, analyze and share multibeam data in real time



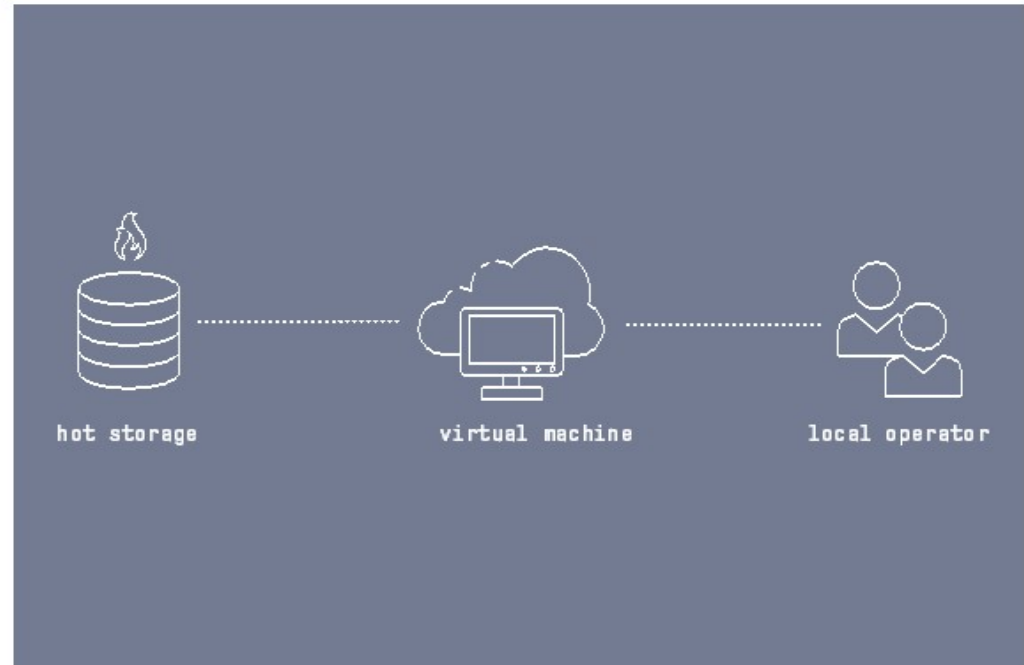
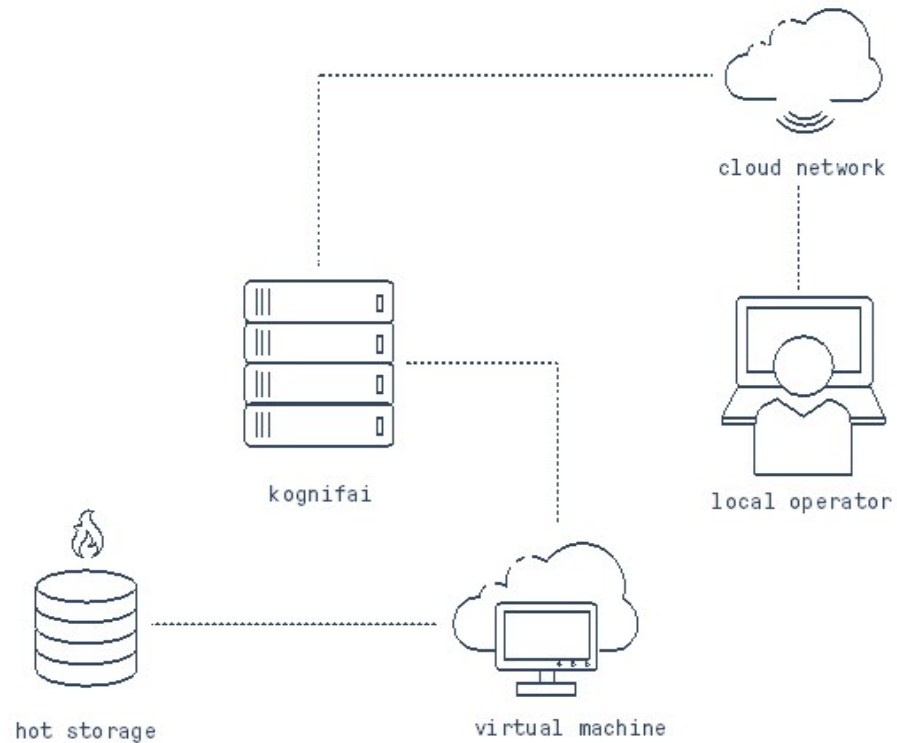
# Storage

Managing your data in the Cloud



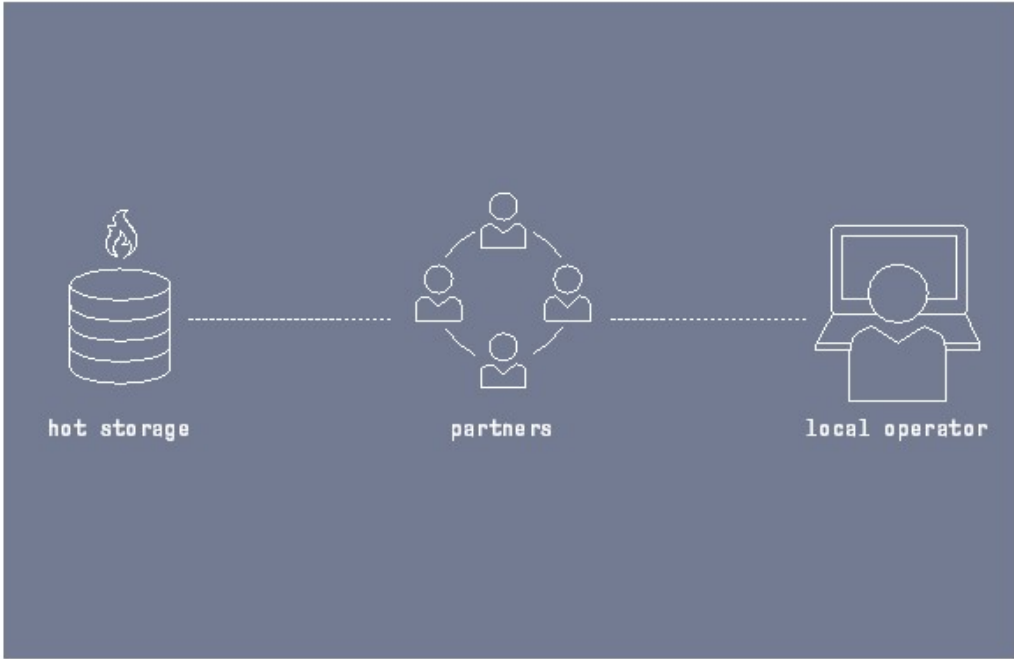
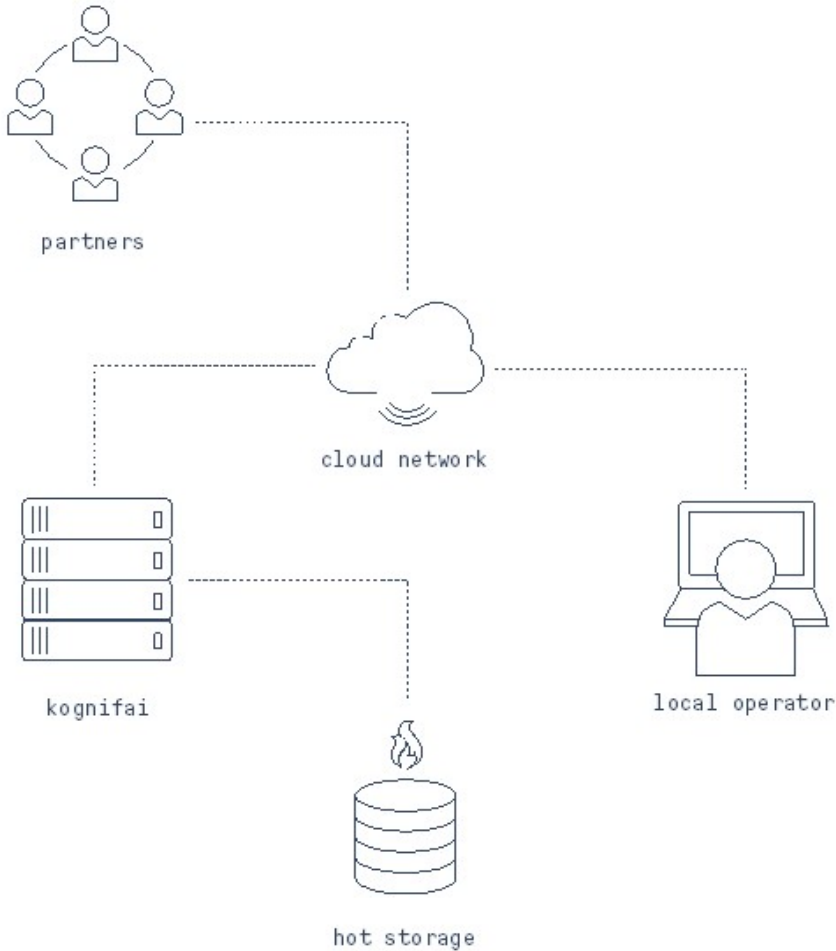
# Virtual Machine

Your completely customised, personal workspace



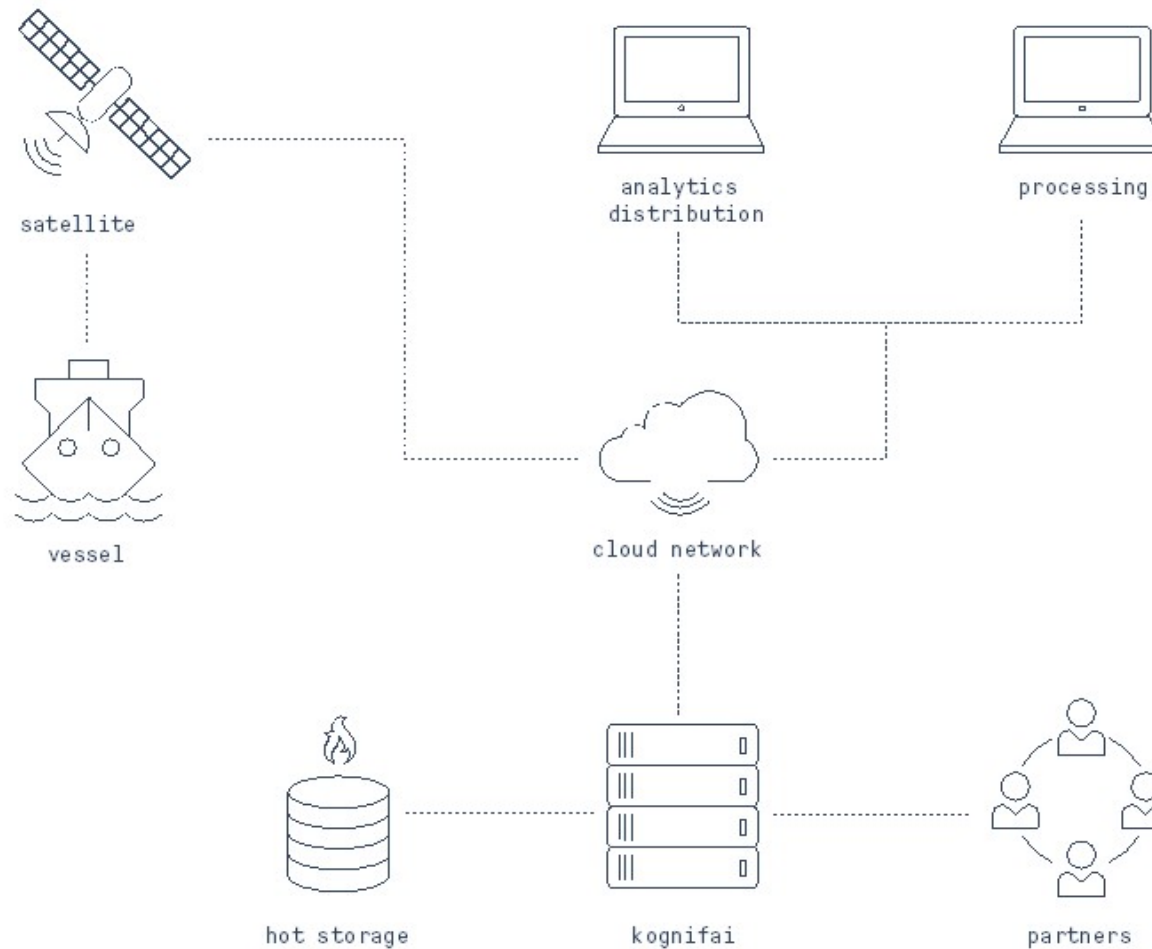
# Partners

Every cloud can talk to each other in the virtual atmosphere



# Real time

Everyone can work on data in real time - no matter where you are in the world



## Accessing our Capabilities

We provide a flexible approach to delivering capability, from sale to service.



Standard payment terms for marine robotics systems up to 36 months

Access to the Norwegian export finance scheme: GIEK

Global equipment rental through Kongsberg Maritime Ltd.

System and Data as a Service to access our latest technology without CapEx





KONGSBERG

# Kongsberg Maritime Marine Robotics

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