



**MINISTÈRE
DES ARMÉES**

*Liberté
Égalité
Fraternité*

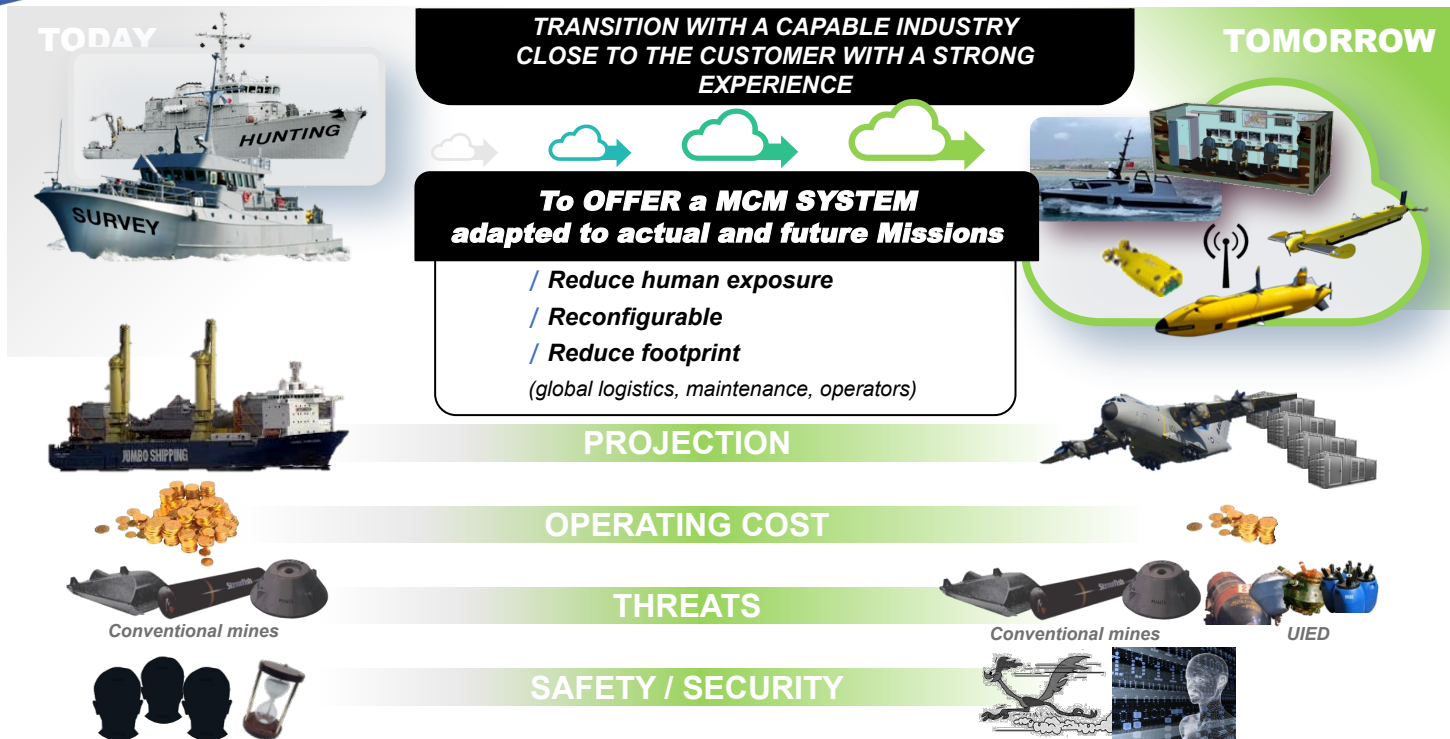


CNE 2023 – MMCM Program

Operational Scenario Task Vignette
DCL Performance Demonstration



Introduction



Maritime Mine Counter Measure – Program overview



MMCM Programme

Signatures Stage I/Prototype : 2015
Stage II/Production : 2020

Thales has developed and will provide to DGA and Marine Nationale an operational MCM system based on maritime autonomous assets

Delivery of stage I DCL systems to UK and France: End of November 2021

Proven at sea on operational scenarios



Operational scenarios requirement

- OSTV = Operational Scenario and Task Vignettes
 - An operational scenario is divided in vignettes
 - The Task Vignettes represent specific MCM activities that the Primary system should conduct
- Why include operational scenarios in the system requirements ?
 - Vignettes are expected to demonstrate the ability of the Primary System(s) in particular conditions whereas operational scenarios are to provide stress on the architecture of this Primary system to prove its coherency, its ability to fulfil the missions with global constraints.

OSTV in a nutshell

Seaport Access (SA)



Mine disposal
Confined waters

Homeland Security (HS)



Strong current
Deep waters
Mine disposal

Amphibious Operation (AO)



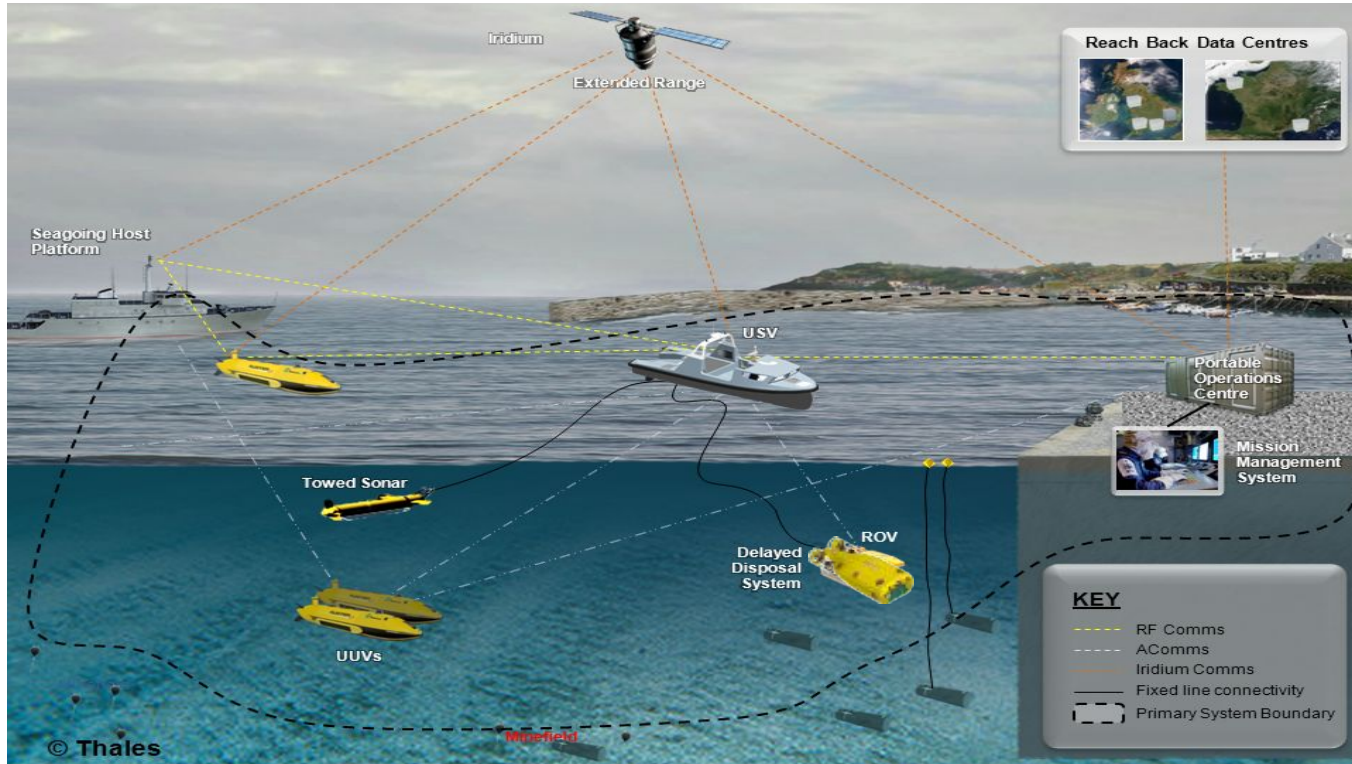
Covert operation
Delayed synchronised
disposal

Choke Point (CP)



Strong current
Drifting mines

Maritime Mine Counter Measures (MMCM) : PATHMASTER Solution



Which asset for which scenario

Amphibious Operation

Covert operation
Delayed synchronised disposal



Urban Port

Strong current
Deep waters
Mine disposal



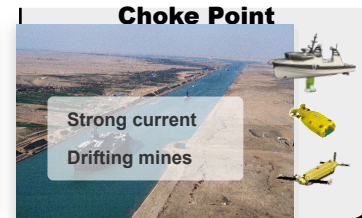
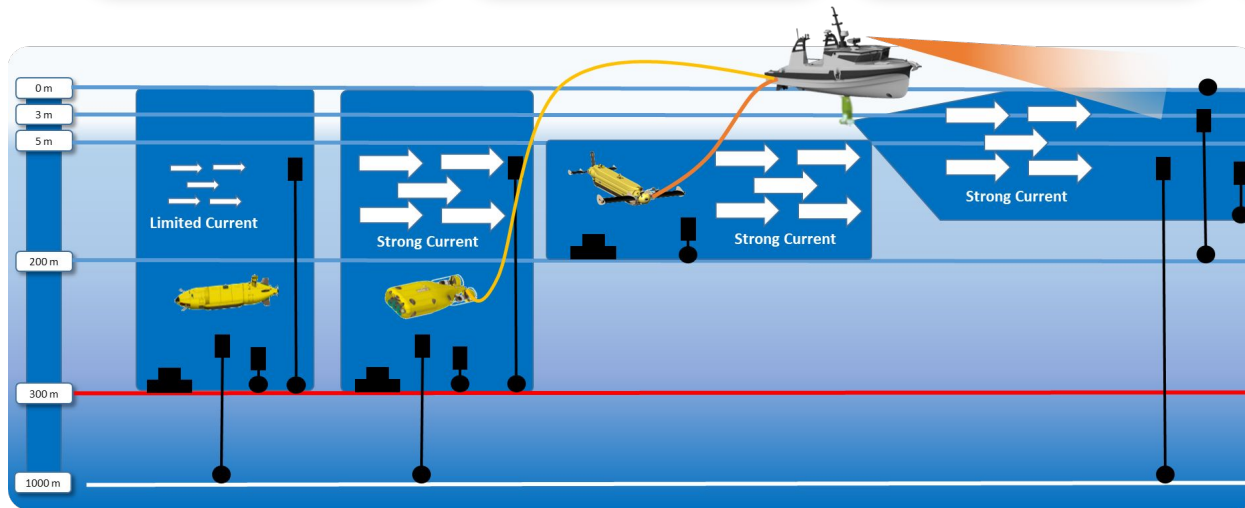
Seaport Access

Mine disposal
Confined waters



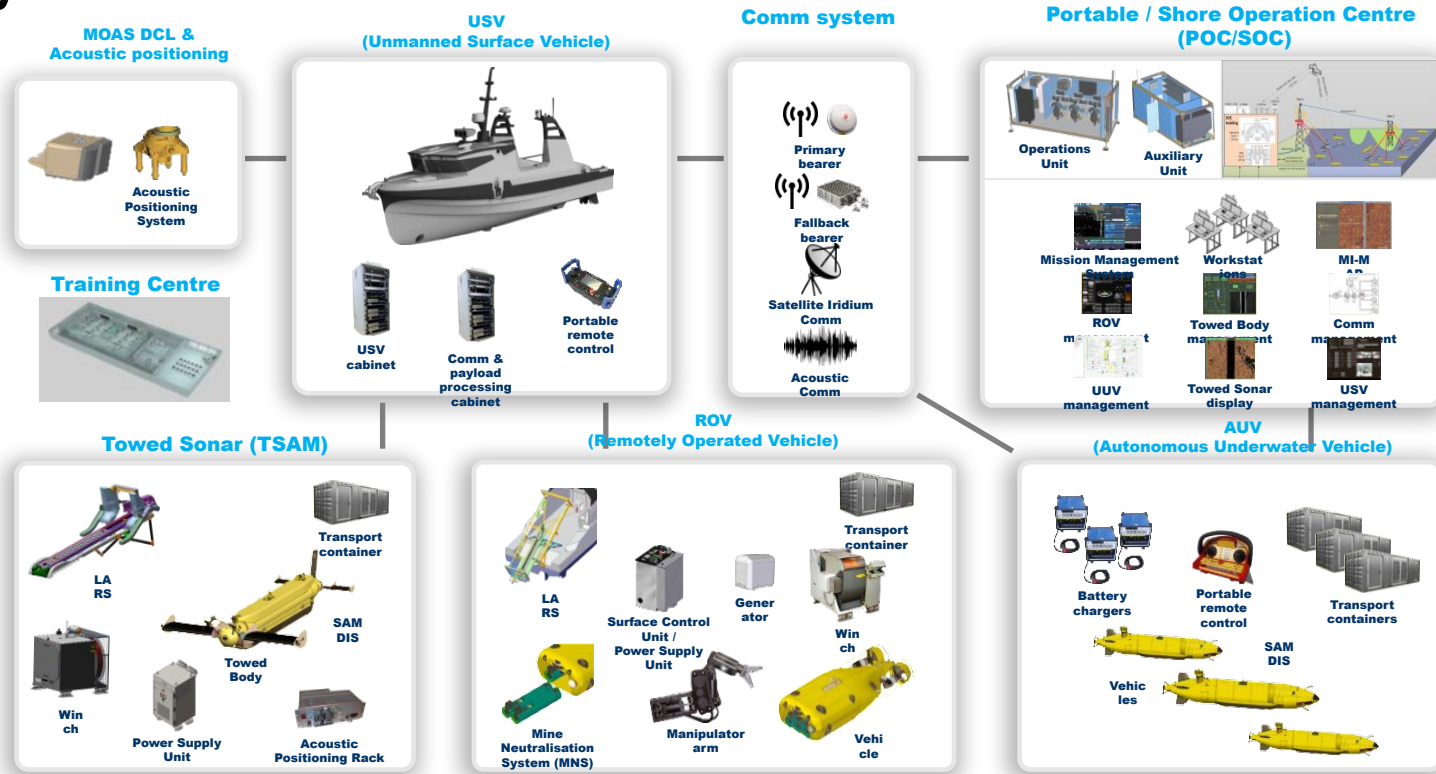
Choke Point

Strong current
Drifting mines

Assets optimisation & Operational redundancy to ensure high level of service / availability

System Overview



Definitions of Pc, Pfa and Accuracy

Metrics and definitions

Classification	Classe	Mine	Non Mine (rocks)
MILCO		True Positive (TP)	False Positive (FP)
NO MILCO		False Negative (FN)	True Negative (TN)

- **Probability of classification** – mines classified MILCO / number of mines

$$Pc = \frac{TP}{TP+FN}$$

- **Probability of false classification**– non mines classified MILCO / number of non mines

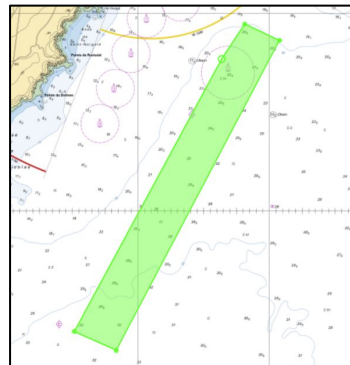
$$Pfc = \frac{FP}{FP+TN}$$

- **Probability of good classification of mine and non mines (accuracy)** – number of correctly classified objects / total number of objects

$$accuracy = \frac{TP+TN}{TP+FN+FP+TN}$$

Focus on SA3 : clear the inner approach to the port

- Assets :
 - 3 AUVs with SAMDIS
 - 1 POC
- Mine threat :
 - Ground mine
 - Tethered mine
- **Main objective : no missed mine**
- Environmental conditions encountered



0,2 knt



12 knts



sea state
2



max
30m
min 20m



600

Focus on SA3 : sonar results

- **Uncluttered seabed,**
but many fishes and ripples areas
- PMA on 3 consoles (5 operators)

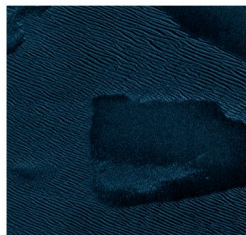
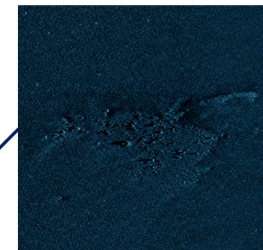
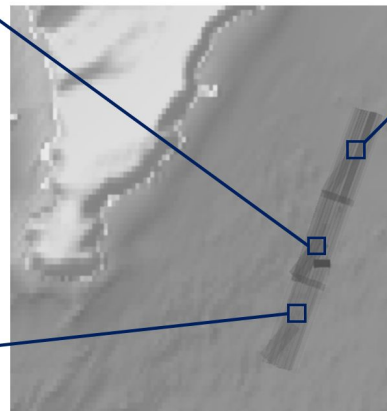
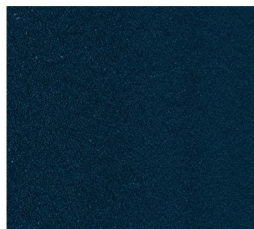


2h30

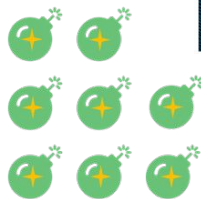






Pc > 99%

Pfa < 1%



Asset used	3x AUVs + POC
Mission area (NM²)	1,08
number of contacts	210
Classification Pfa	< 0,5 %
Accuracy	> 99 %



-  Mines correctly classified
-  Mines misclassified
-  Mines not detected
-  Correct mine-type found

Focus on CP1 : find a safe route in a choke point

- Assets :
 - 1 USV/MOAS + TSAM with SAMDIS
 - 1 POC
- **In-Stride** TSAM on 1 console
- **Main Objective** : very high probability of classification on both Mines and non Mines
- Environmental conditions encountered



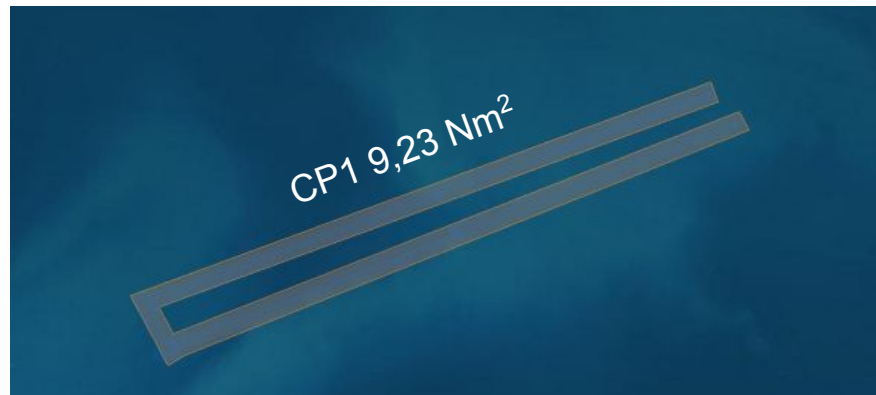
sea state 2



max 60m
min 40m



5 000



Focus on CP1 : sonar results



20h



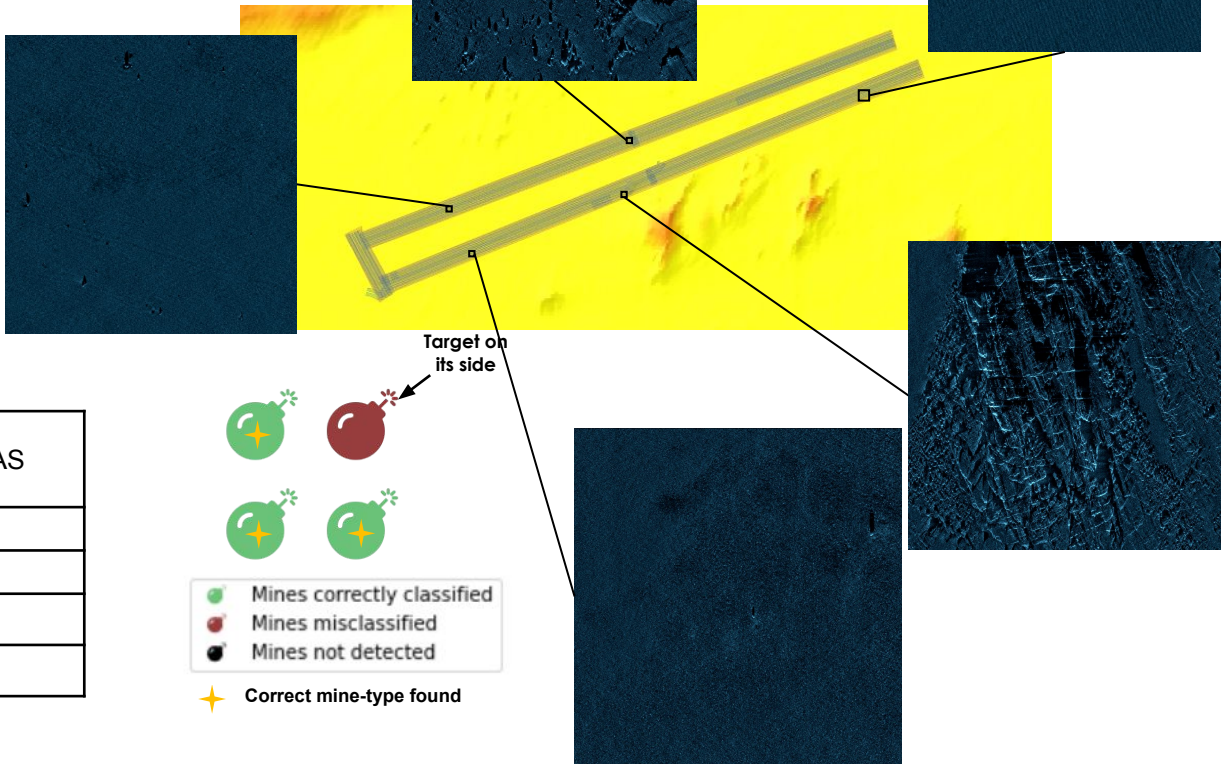
In-Stride
>1400 contacts



<15 MILCOs



Accuracy
>99%



Asset used	1x TSAM 1x USV/MOAS 1x POC
Mission area (NM²)	9,23
number of contacts	1446
Pfa	< 0,5 %
Accuracy	> 99 %

Focus on AO2 : Survey of the boat lane

- Assets :
 - 1 USV/MOAS + TSAM with SAMDIS
 - 3 AUVs with SAMDIS
 - 1 POC
- In-Stride TSAM+MOAS and PMA-AUV
- **Main Objective : Very few mine misses with limited false alarms on a route**
- Mine threat :
 - Ground mines, classic and stealth
 - Short Tether
 - Anti-landing mine
- Environmental conditions encountered



<1 knt



23knts



sea state
3/4



29knt
s



max 45m
min 7m



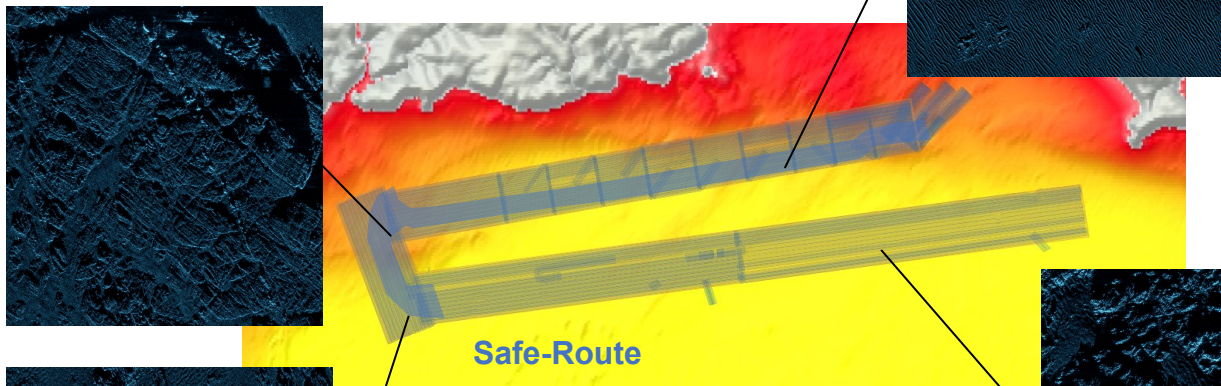
16
000



Focus on AO2 : high sea state experience



Focus on AO2 : sonar results



Pc > 95%

Pfa < 2%



> 2000



≤ 50

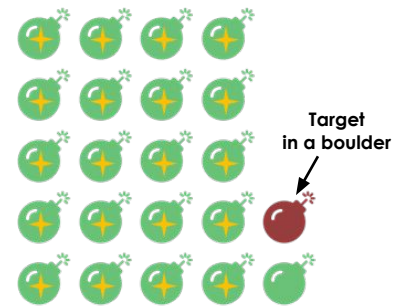
MILCOs







40h

100m stride

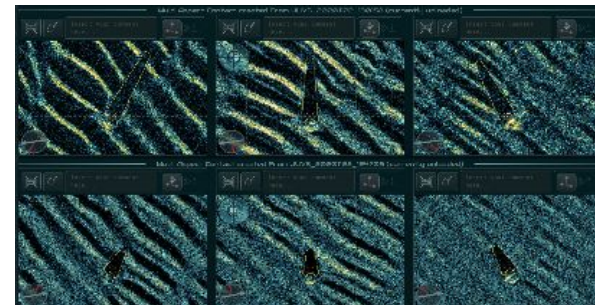
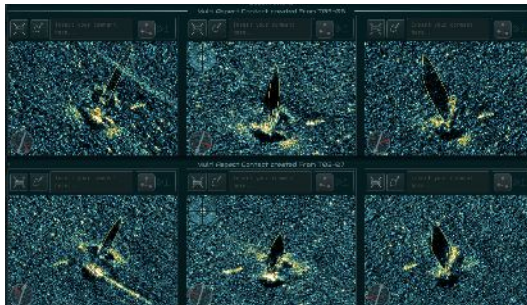
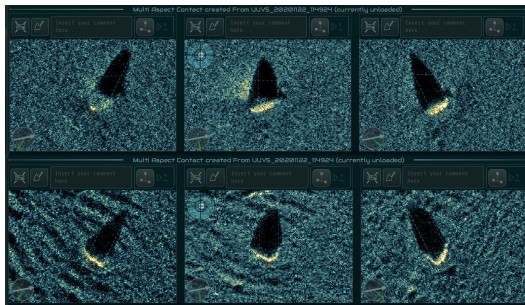
PMA



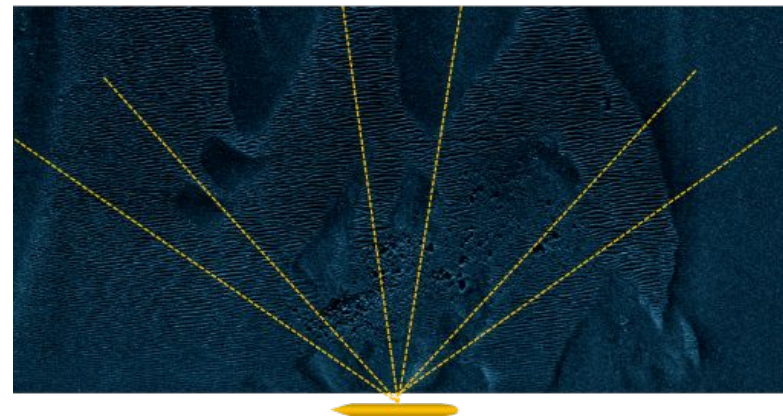
-  Mines correctly classified
-  Mines misclassified
-  Mines not detected
-  Correct mine-type found

Asset used	1x TSAM 1x USV/MOAS 3x AUVs + 1xPOC
Mission area (NM²)	28,52
number of contacts	>2000
Pfa	< 2 %
Accuracy	> 96 %

MMCM – OSTV : sea proven mine-hunting multi-view SAS



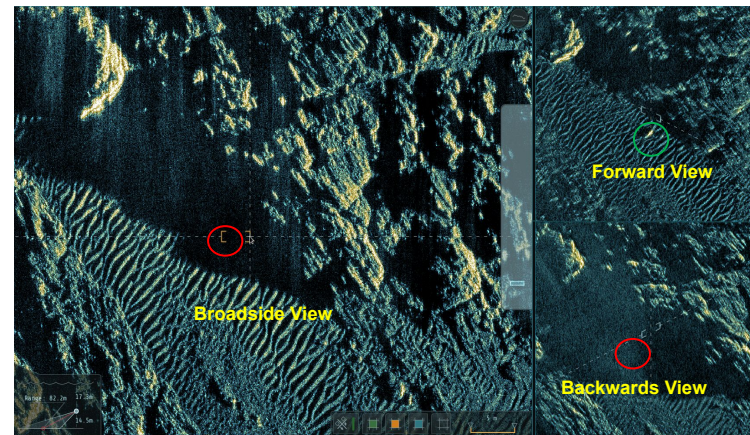
- SAMDIS Multi-view SAS feature:
 - High detection and classification performance
 - Low false alarm rate limiting time consuming identification
 - Increase the operational envelope
 - Reduce the mission time
 - More than 10 000 NM of tracks during industrial tests



MMCM – OSTV : Key facts and figures

Enhanced MCM performance:

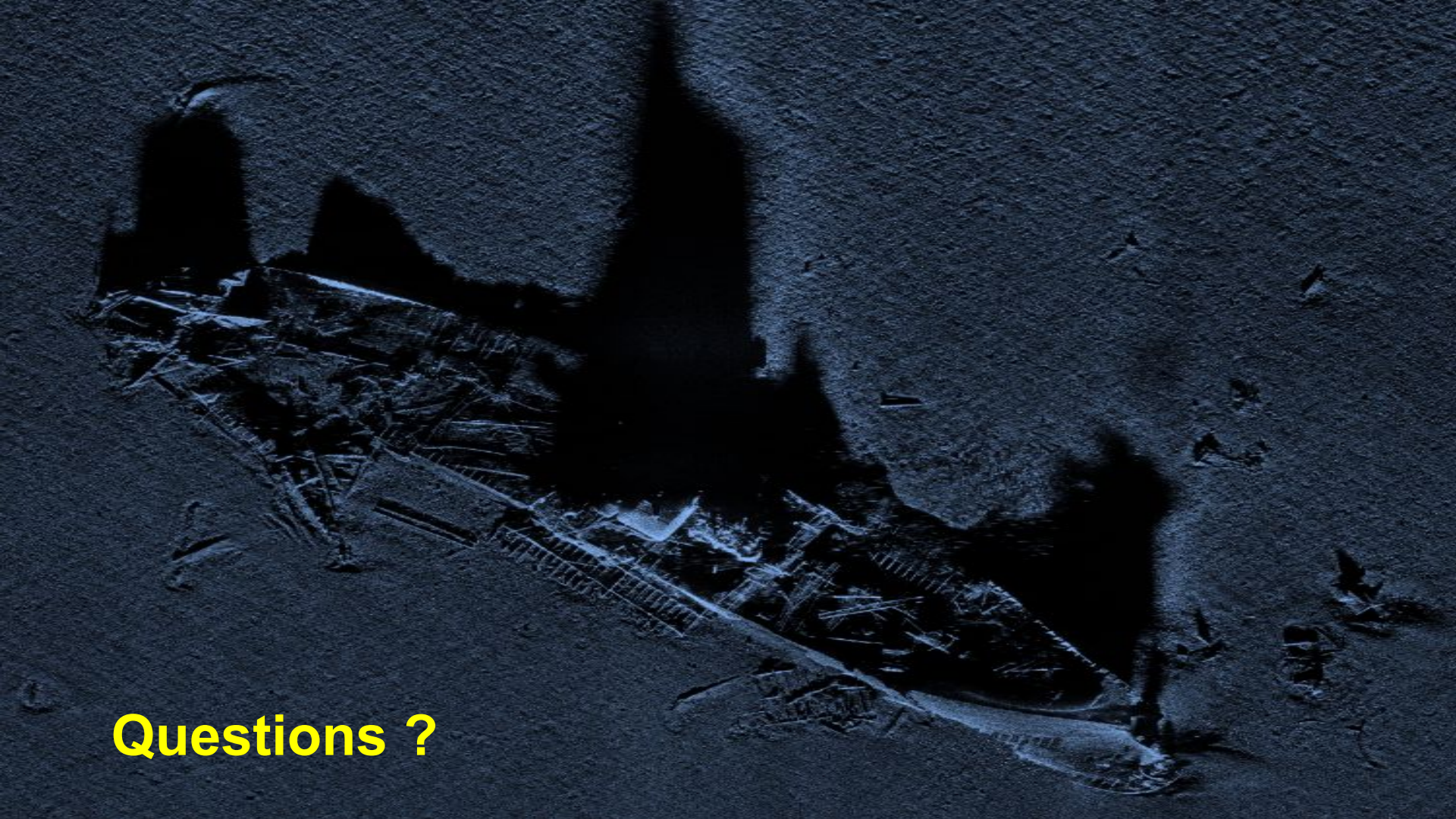
- Human risk dramatically reduced
- Time / people: factor 2 to 3 saving versus conventional Mine Hunter
- 200 km² covered (~30 000 football fields) during day and night
- Depth: from 7m to 300m
- Sea state 3 / wind 25 knots (35 knots in gust) / 3 knots of current
- Covert amphibious operation becomes possible
- Bottom type: very dense areas become accessible
- Easy & fast deployment





Next steps and Future evolutions

- Production contract (MMCM Stage II) ongoing since 2020
 - Systems to be delivered for FR and UK in 2024
 - Beginning of the qualification : Autumn 2023
- Lessons learnt thanks to the prototype evaluations
 - Some modifications already implemented on the production system
- Embedded Technologies evolve quickly so, necessary to think about future increment
 - With an open architecture
 - Smaller SWaP SAMDIS payload for the next generation of platform



Questions ?