Digital Twin: a bridge between simulation and real world in the Maritime Environment

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Introduction

> NATO is reinforcing its maritime posture and is taking concrete steps to improve the Alliance's overall maritime situational awareness, deter and defend against all threats in the maritime domain, uphold freedom of navigation, secure maritime routes and protect its main lines of communication.
>
> — NATO HQ

What is it all about?

Aim of collaboration with IT-Navy

Is DT applicable for the underwater domain?

Is it useful for the nations?

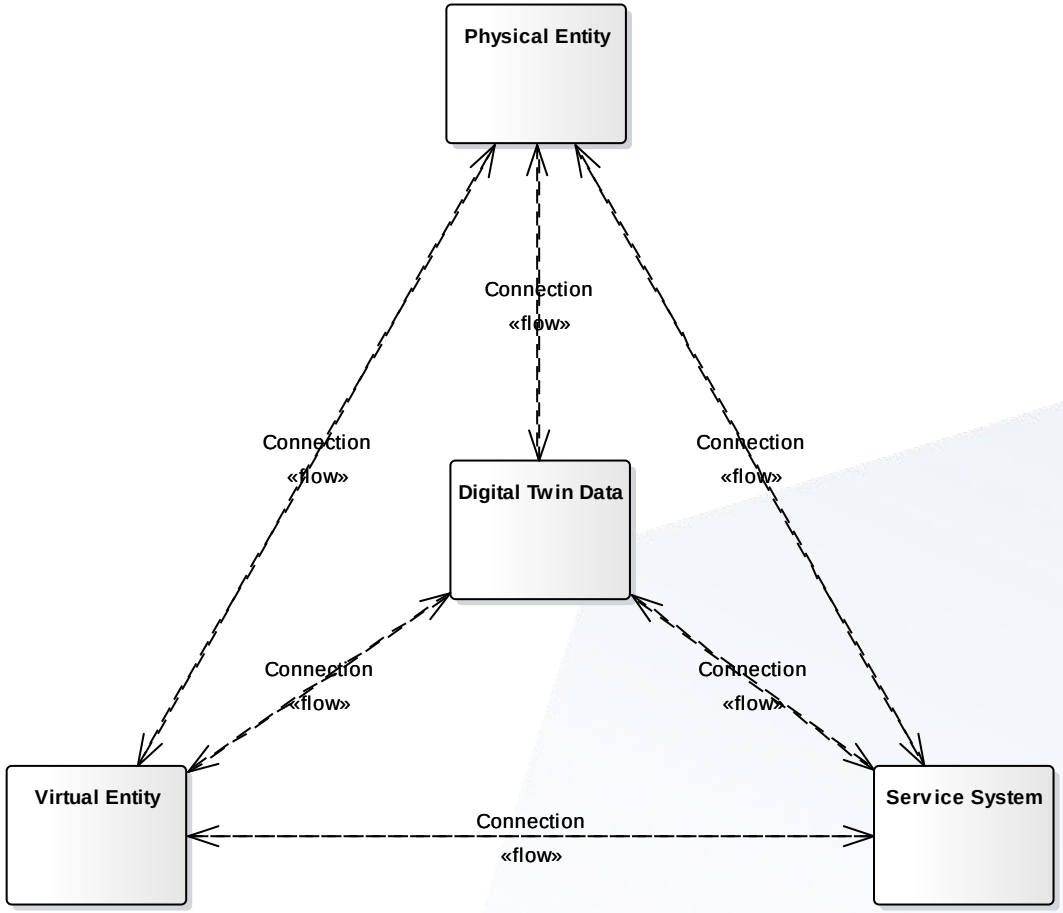
- Propose uses for DT in underwater autonomy
- Investigate an architecture that addresses scenarios

Environment characteristics

- Limited communication
- No GPS
- No light

Key:
- Explored
- Unexplored

State of the Art



Health management / Maintenance

Monitoring

Industrial process optimization

Environment

Mission engineering/combat effectiveness

Augmented Testing

Training

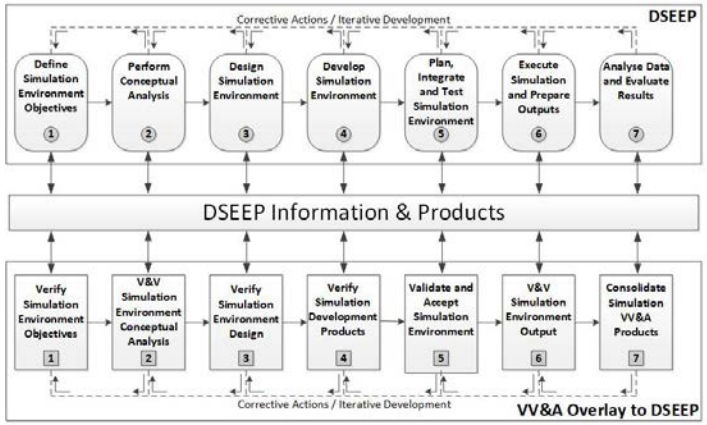
UNDERWATER

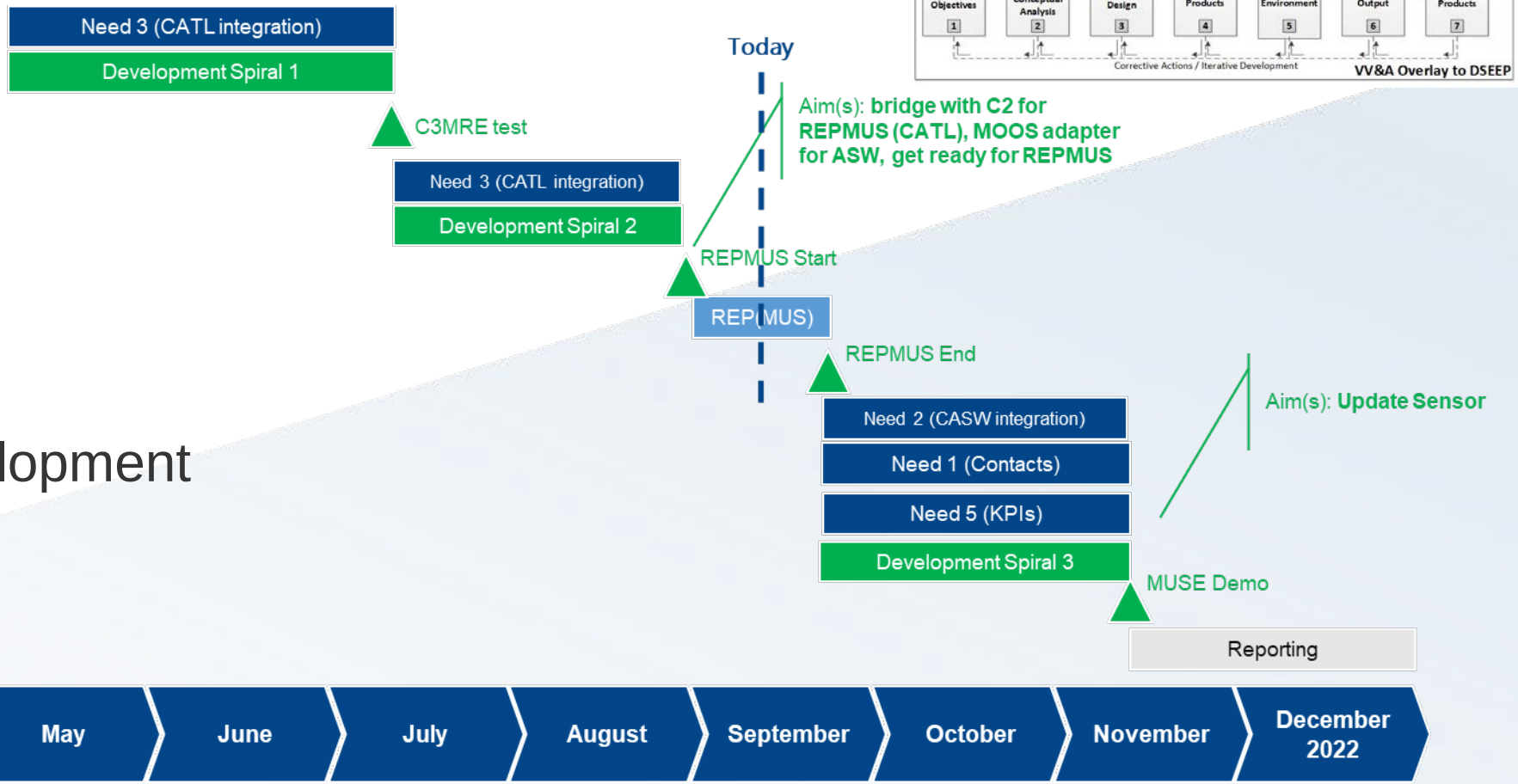
Monitoring in absence of comms

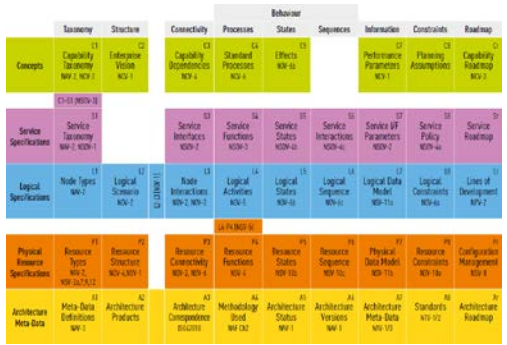
02. Methods

Standards

- DSEEP
- NAF
- Spiral and Agile Development







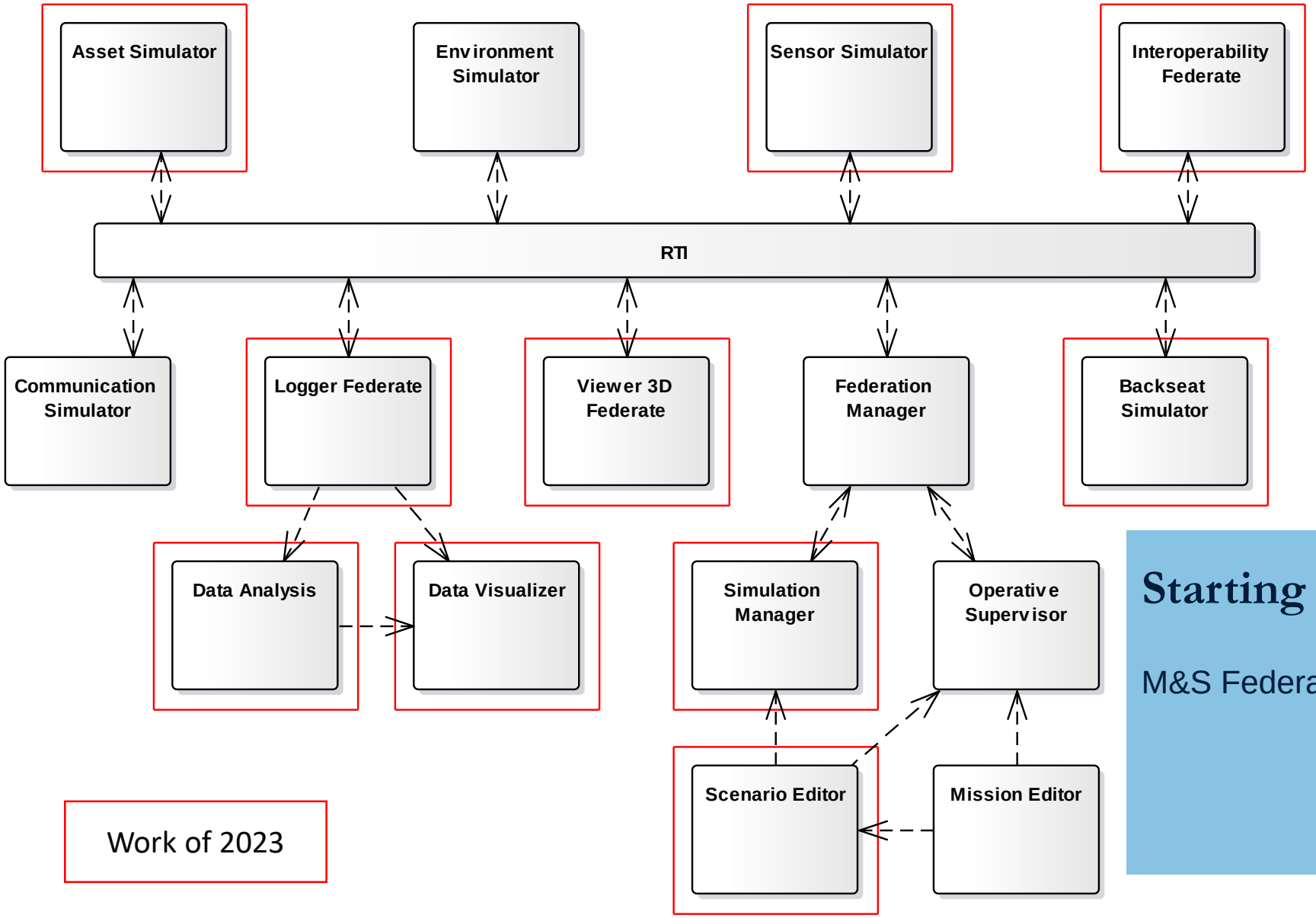
Collaboration

ITAN

- CSSN – Centro Supporto e Sperimentazione Navale
- Meetings: recurring weekly
- Aim: Definition and Validation of the scenarios

Industry

- Leonardo
- Fincantieri

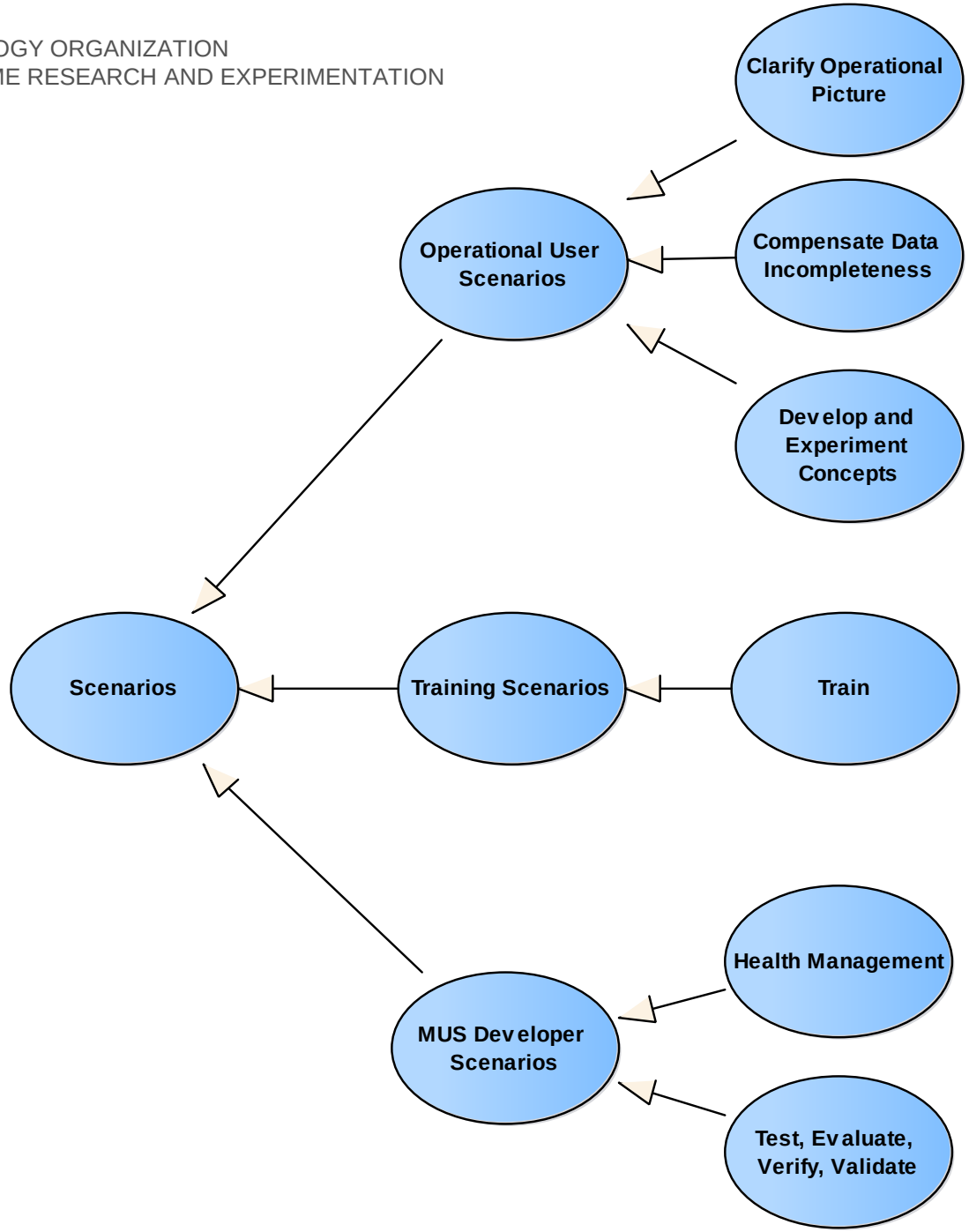


Work of 2023

Starting Point

M&S Federation

03. Results

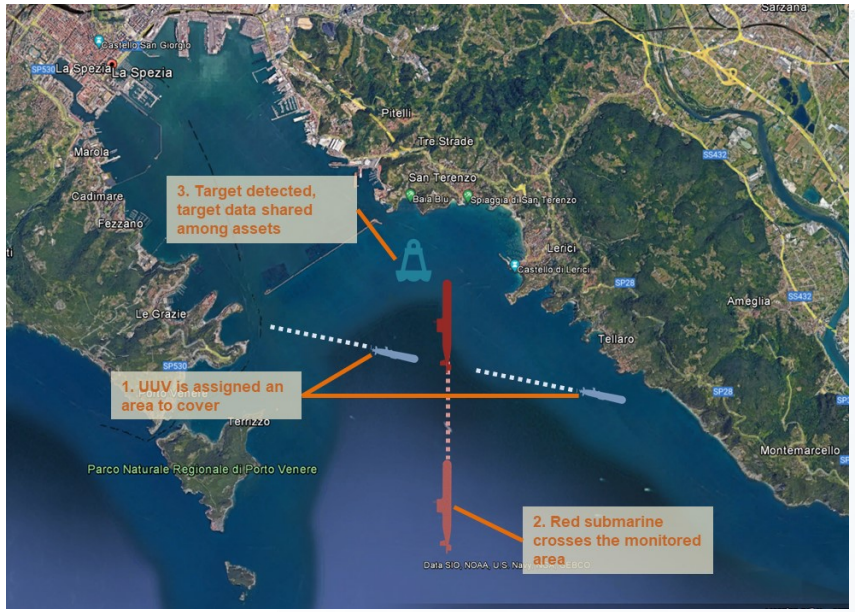


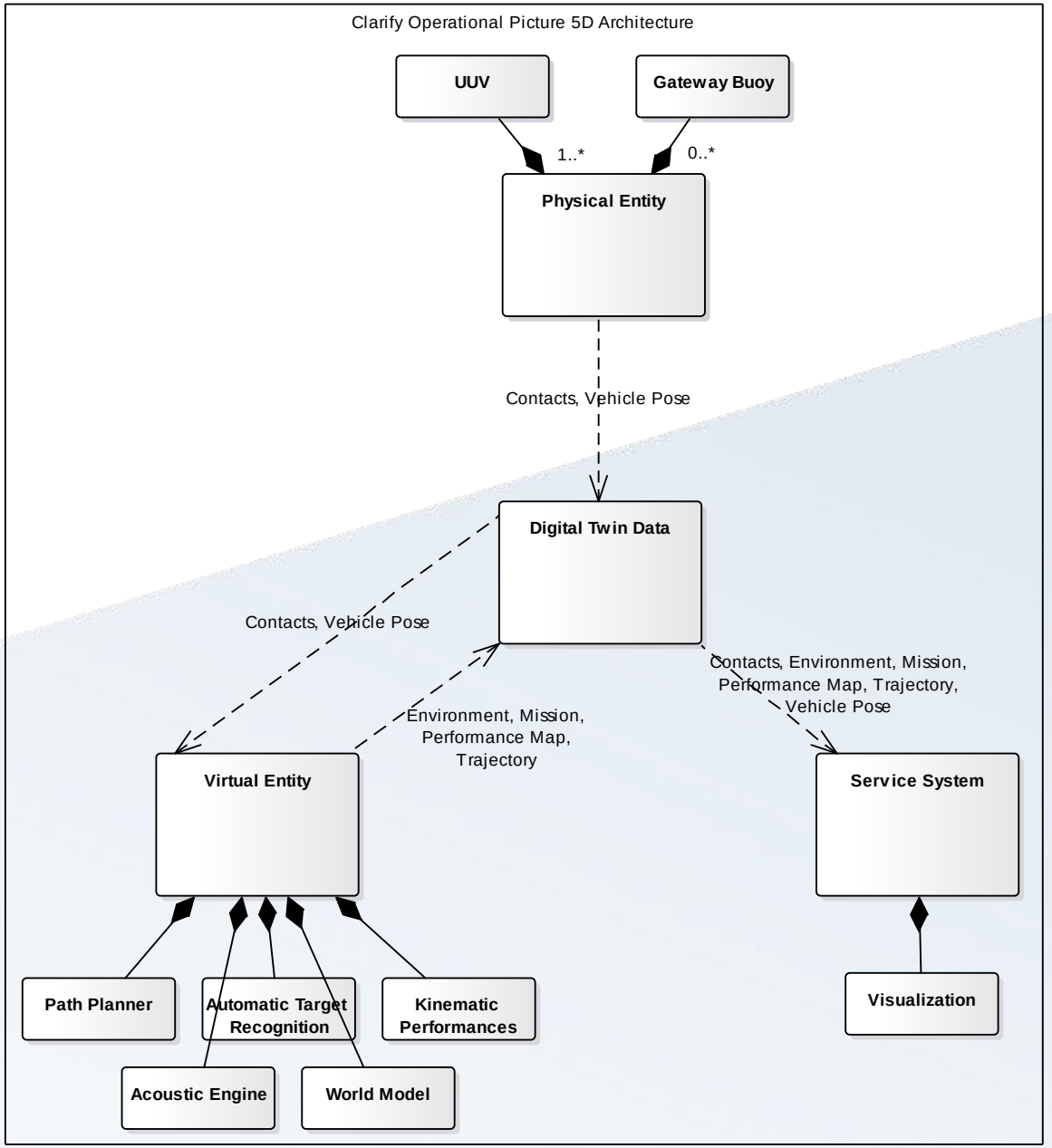
Scenarios

3 end users, 6 scenarios

Scenario 1: Clarify Operational Picture

Lack of communication during underwater operations leaves the operator of a MUS fleet blind for consistent portion of the mission duration





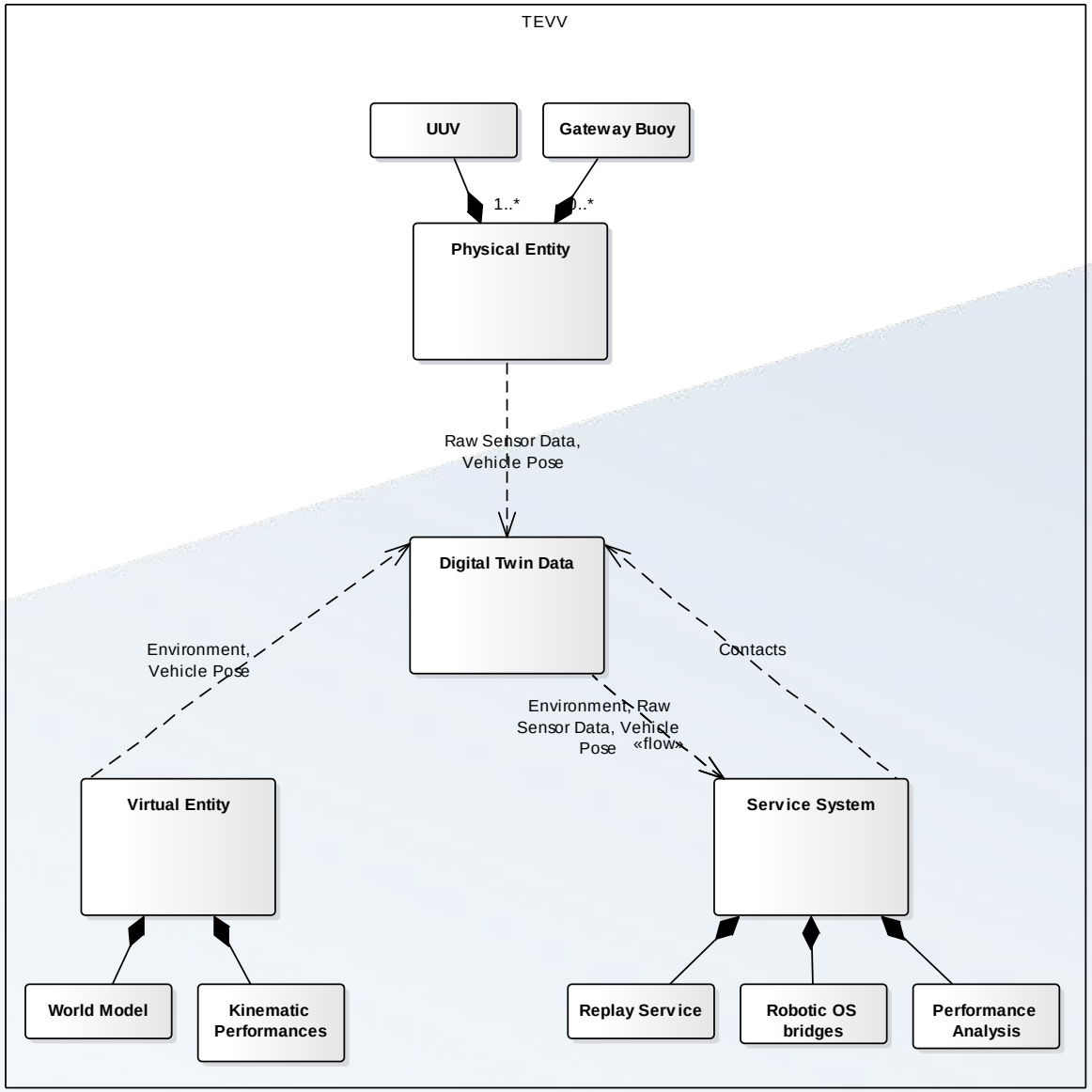
Why is it relevant to clarify the operational picture?

Land/Air operation

Underwater Operation

Scenario 2: Test Evaluate Verify and Validate

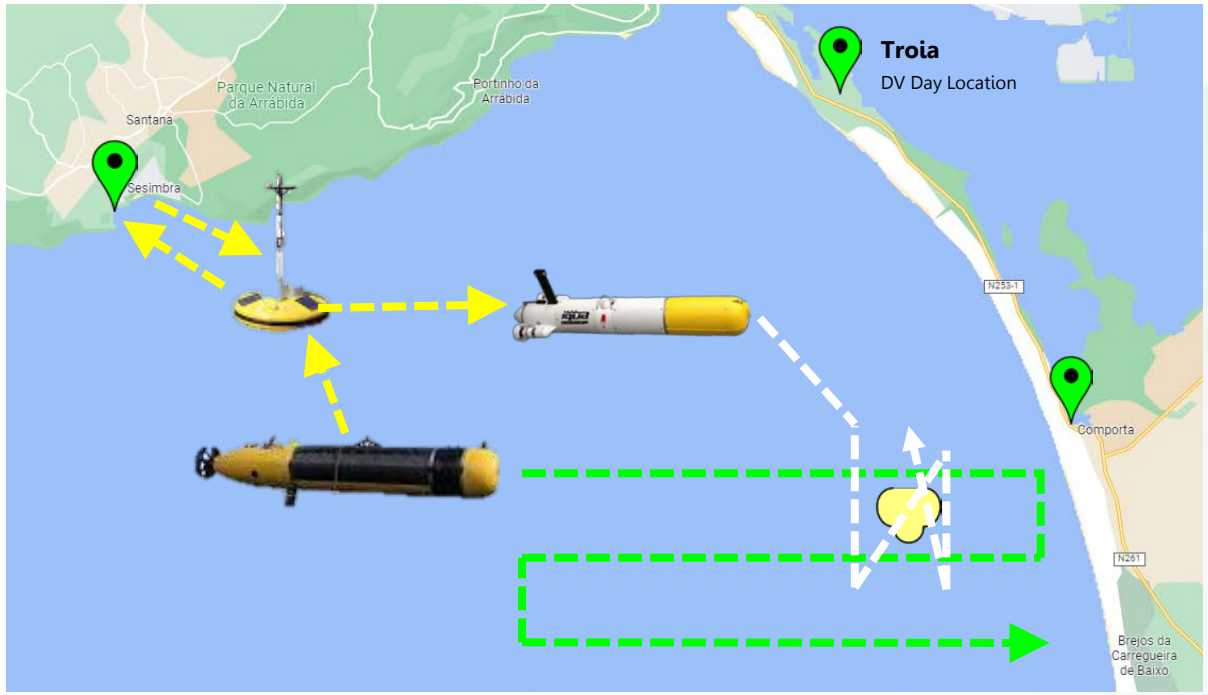
Use raw data collected during operations to test systems update and validate and verify deployment of new AI modules before going at sea

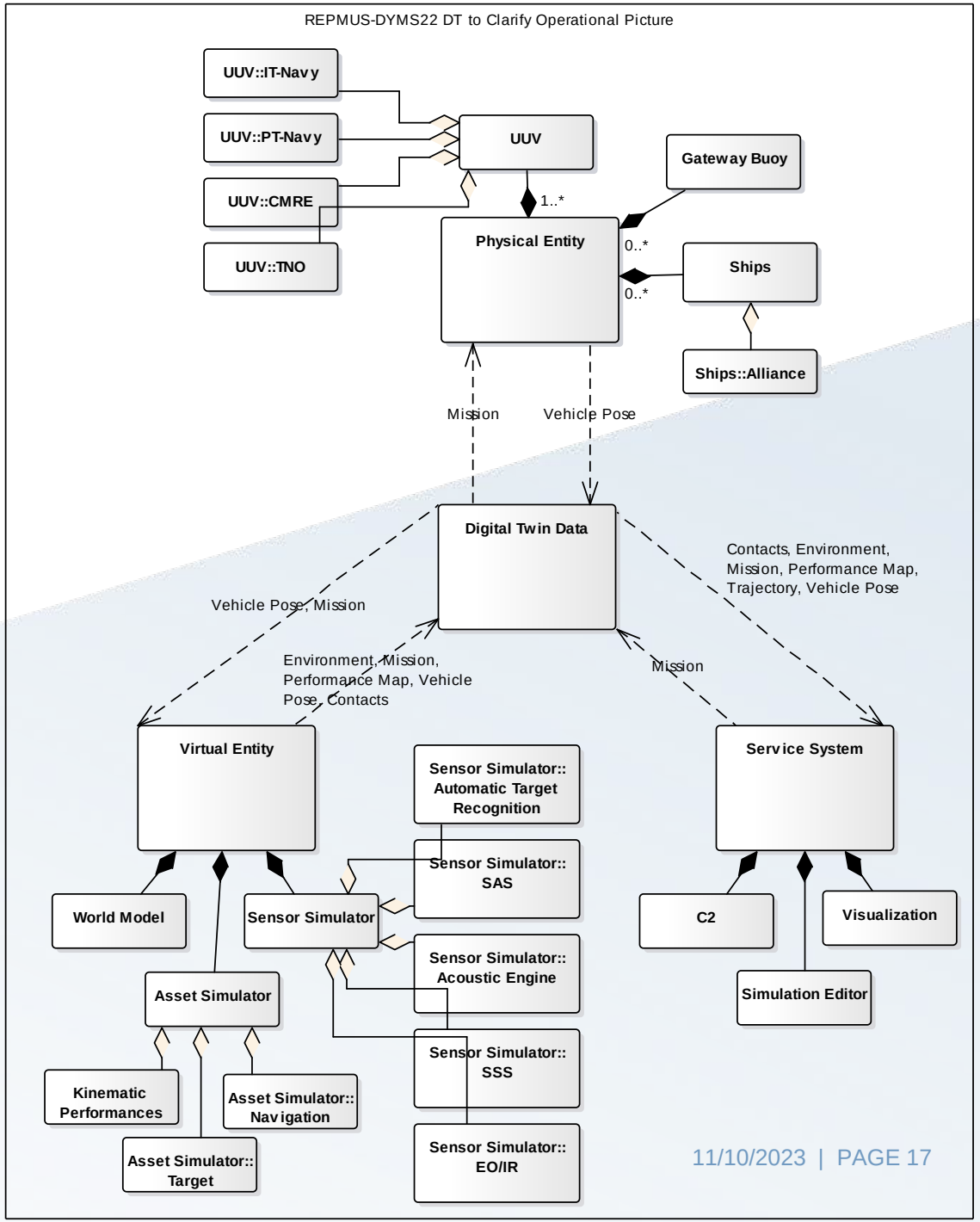


04. Discussion

MCM/ASW - use M&S DT to clarify the common operational picture during the exercises

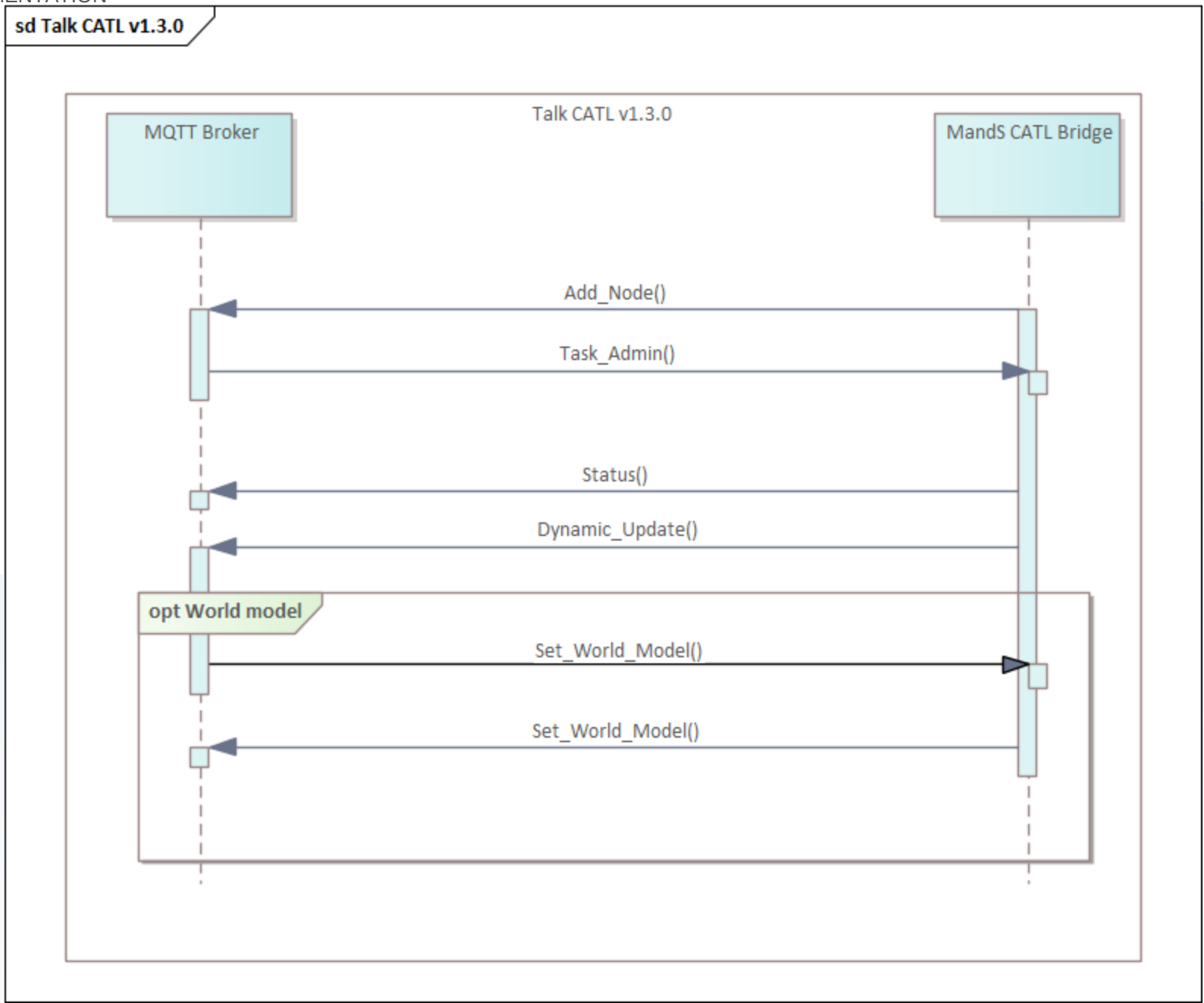
- **Visualize** real assets in a 3D realistic environment
- **Augment** real assets with simulated assets executing a parallel mission (ghosting) to highlight discrepancies between realistic operational conditions and initial planning conditions
- **Augment** real assets with simulated sensors to simulate detection performances





C2 to Simulation

- **Status:** Telemetry from and to C2
- **Task Admin:** MCM survey, MCM identification missions from C2
- **Dynamic Update:** Contacts and detections from and to C2
- **World Model:** Regions, missions



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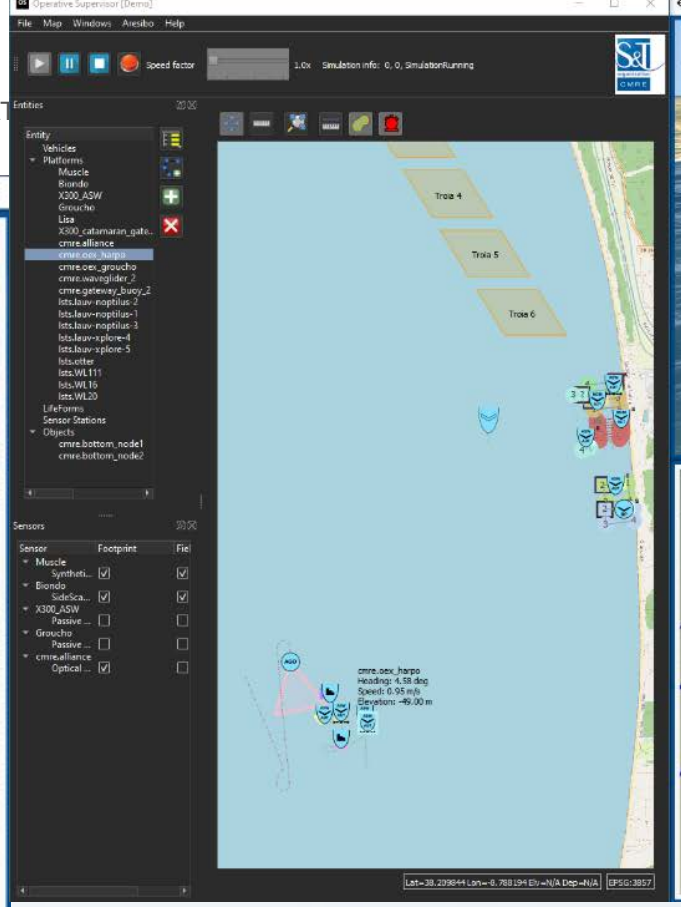
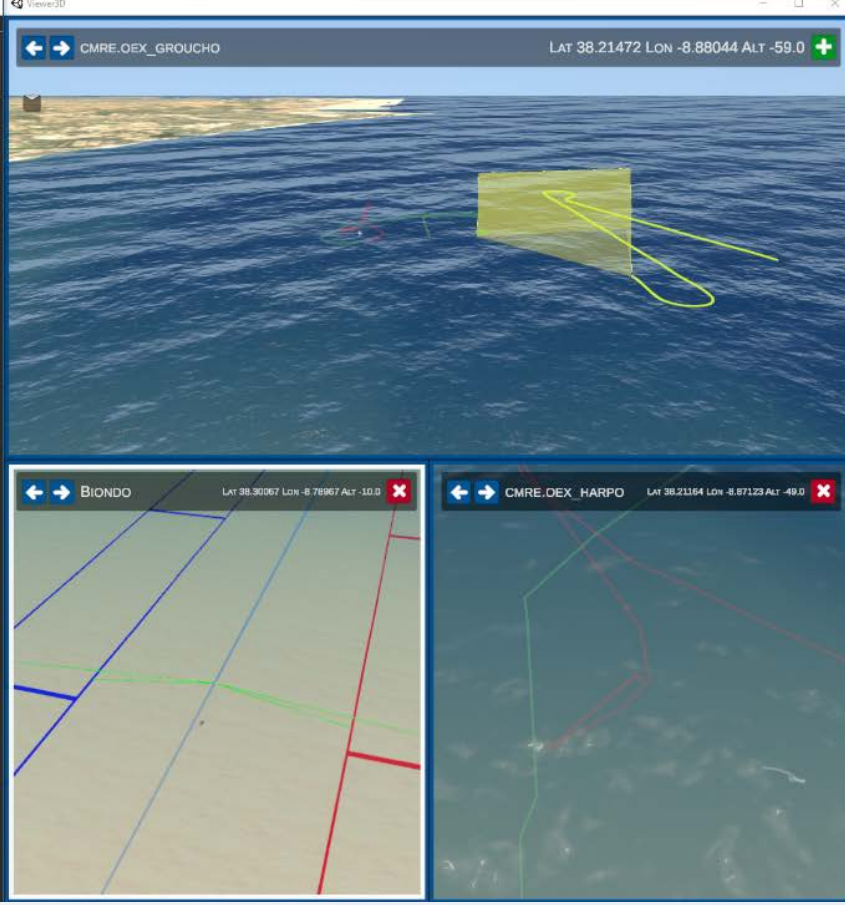
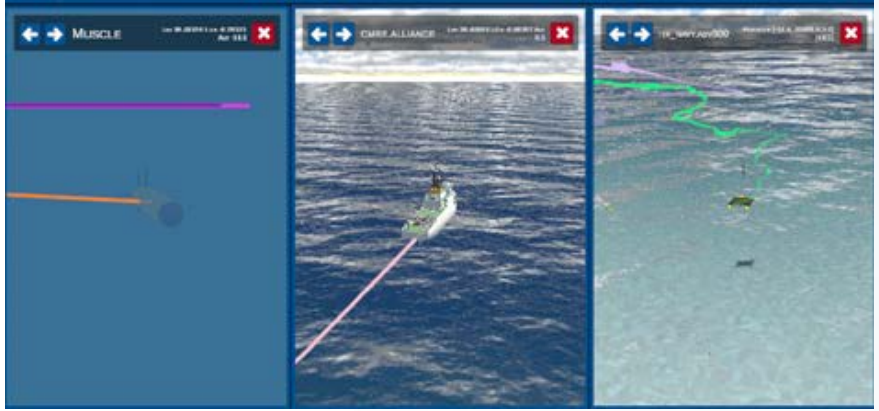
Centre for Maritime Research & Experimentation
La Spezia | Italy

SCIENCE & TECHNOLOGY ORGANIZATION
CENTRE FOR MARITIME RESEARCH AND EXPERIMENTAT







05. Conclusion

Conclusion

- There is a strong interest in the operational community
- It is doable to develop a DT for UW scenarios
- It brings added value
- Working prototype deployed