

2.1.12. EDF-2022-RA-UWW-ODAC: Underwater observation, detection, acquisition and communications

Budget

The Union is considering a contribution of up to EUR 30 000 000 for this topic under the call EDF-2022-RA

Number of actions to be funded: Up to one action may be funded for this topic

Objectives

General objective

Timely and robust detection and monitoring of moving underwater threats (such as submarines, swimmer delivery vehicles (SDV), combat divers, underwater unmanned vehicles (UUV)) in open sea and coastal waters is critical for maintaining sea control, for ensuring freedom to operate own forces, for A2AD operations, for harbour protection, for force protection, and for protection of critical national infrastructure.

Future capabilities need to be effective, mobile, adaptive, scalable, and flexible to counter threats from the underwater domain, leading to new technical and conceptual solutions to be developed. As traditional naval ships will become an increasingly scarce and expensive resource and will not be sufficient to provide the necessary geographical coverage and flexibility needed for the future, research is required on modular unmanned systems for underwater warfare with prerequisite principles of unmanned air, surface and underwater (UxV) standards.

Specific objective

Underwater communication, detection, and monitoring of moving targets are common denominators for traditional warfare areas such as Anti-Submarine Warfare (ASW), underwater surveillance, harbour protection, and seabed warfare. Mission specific sensor solutions and tactical approaches differ in these, despite having common denominators. Timely detection of moving underwater threats at sufficient range is identified as one of the biggest challenges. Providing technical solutions for underwater target detection, allowing to prepare appropriate reaction to a subsurface threat, will therefore impact the whole range of warfare areas mentioned above. The aim is to develop technological novelties at least up to TRL 5.

Scope and types of activities

Scope

The proposal for research on underwater observation, detection, acquisition and communications is expected to make an evaluation of critical technologies for detection of underwater threats for protection of maritime infrastructures and coastal strategic areas and assets, and identify novel technologies for improved situational awareness. This assessment of individual technologies will in a first stage be integrated to demonstrate an improved capability in underwater surveillance in littoral waters. This does not exclude open sea as an environment of operational use for the capability.

The proposal must cover at least the following parts:

- The first part is a scientifically focused part of research topics that today represent critical

shortfalls in the process chain from sensor to underwater situational awareness and challenges in coordinated operation of unmanned system-of-systems. A strong emphasis is on the scientific quality and relevance of these identified research topics. Technology areas and solutions for specific underwater missions, excluding MCM, that must at least be considered are: sensor systems for the detection of underwater threats at long ranges; processing methods for noise attenuation and automated target detection; technologies for target classification, positioning, tracking, and target identification; autonomy and autonomous adaptive operation of UxV; System-of-system architecture and interoperability standards; Command, control, communication and information systems in support of operations

- The second part is a comprehensive demonstration of the project results in a realistic scenario at sea, adapting them to existing UxVs, sensor and communication systems, infrastructure components, and data management systems¹⁴.

An overall system-of-systems (SoS) approach must be used that puts together experimental configurations of unmanned mobile sensor platforms, rapidly deployed distributed autonomous nodes, ad-hoc underwater and radio communication networks together with an overall combat management system (CMS) for establishing situational awareness of the underwater threat.

Different components of the system of systems are expected to bring increased flexibility through a modular toolbox, comprising a range of systems focused to be deployed as autonomous sensors or to be adaptable to existing or newly developed maritime platforms.

Appropriate level of human control must be respected also in proposals containing solutions with autonomous features.

Types of activities

The following types of activities are eligible for this topic:

Types of activities (art 10(3) EDF Regulation)		Eligible?
(a)	Activities that aim to create, underpin and improve knowledge, products and technologies, including disruptive technologies, which can achieve significant effects in the area of defence (generating knowledge)	Yes (optional)
(b)	Activities that aim to increase interoperability and resilience, including secured production and exchange of data, to master critical defence technologies, to strengthen the security of supply or to enable the effective exploitation of results for defence products and technologies (integrating knowledge)	Yes (optional)
(c)	Studies , such as feasibility studies to explore the feasibility of new or upgraded products, technologies, processes, services and solutions	Yes (mandatory)
(d)	Design of a defence product, tangible or intangible component or technology as well as the definition of the technical specifications on which such design has been developed, including partial tests for risk reduction in an industrial or representative environment	Yes (mandatory)
(e)	System prototyping of a defence product, tangible or intangible component or technology (prototype)	No
(f)	Testing of a defence product, tangible or intangible component or technology	No

(g)	Qualification of a defence product, tangible or intangible component or technology	No
(h)	Certification of a defence product, tangible or intangible component or technology	No
(i)	Development of technologies or assets increasing efficiency across the life cycle of defence products and technologies	No

The proposals must include study and design activities. The proposal may include generating knowledge and integrating knowledge activities.

The proposals must substantiate synergies and complementarity, while avoiding duplication, with concepts and architectures developed in complementary ongoing European work streams and projects where relevant.

The following tasks must be performed as part of the required activities:

- For studies, supported by experimentation: In-depth research that address the most critical technology gaps to enable capabilities for underwater detection, classification, tracking and surveillance of underwater moving targets, as well as to enable capable and reliable communication links within the SoS.

- For design, including demonstration: a final comprehensive SoS demonstration involving state-of-art unmanned and autonomous systems that may be configured to represent a complete process chain from detection-to-awareness, playing a realistic military scenario and using realistic moving targets in real environmental conditions. The demonstration must implement results from the scientific studies in such a way that the impact of each of the studies has a potential operational capability, will be clearly visible in the demonstration. In addition, sub-systems to the SoS should be demonstrated.

The tasks must address at least:

- Methods, technologies, systems and devices for the detection of underwater moving threats at long ranges, their classification, positioning and subsequent tracking. These have to consider covert detection solutions, such as multi-static and distributed systems. Also automated target detection has to be addressed. In addition, methods related to mitigation of environmental influence on detection have to be addressed. Autonomy and autonomous adaptive solutions to ameliorate the probability of detection, classification, positioning and tracking of underwater moving targets have also to be addressed.

- Methods and technologies for robust and resilient communication for an underwater system of systems with the aim to establish situational awareness of the underwater threats

A final demonstration will serve as an instrument to show to the military community the results of the targeted research activities, present potential military value and identify technology shortfalls that need to be addressed in subsequent activities in nations and in EU.

The SoS design must respect an open architecture approach and interoperability standards.

Additional tasks may address other specific shortfalls in unmanned and autonomous technologies and coordinated operation of SoS may be addressed. The following tasks may be performed as part of the eligible activities:

- Research on novel technologies for accurate target positioning and tracking. These may include solutions for active and passive arrays and towed arrays mounted on unmanned vehicles (UxV).

- Research on Command, control, communication and information systems in support of operations. For underwater communication: signal processing using novel processing techniques for robust, long range and adaptive communication, including adaptive networks. These can include novel techniques and standards for the implementation of next-generation underwater communication networks.
- Research on enablers for autonomous operations of UxVs in order to develop a consistent preliminary operational system of systems - such as; robust precision navigation, adaptive behaviour, long endurance (high efficiency energy sources), launch & recovery (e.g., UxV deployment platforms - such as military vessel specially designed to launch and recover naval UxV), underwater infrastructure networks
- Research on Human machine interface (HMI).
- Research on Internet of Underwater Things (IoUT, or UIoT) applications including all characteristic layers of IoUT (perception, network and application) and approach to solve the challenge of detection of underwater threats at long distance.

Functional requirements

The proposal should meet requirements for demonstrating a military scenario where detection, acquisition, and timely communication of underwater threats represent the core innovation part of the project.

The proposed solution should:

- Improve and speed up detection, tracking and classification of underwater moving threats especially in most demanding conditions and complex environments (coastal areas, reverberations, maritime traffic, sea state, environmental noise)
- Involve improved or new generation of sensors (active / passive sonar, magnetic anomaly detectors (MAD), hydrophones, active and passive sonobuoys, etc.).
- Have improved capabilities for underwater data connectivity to other equipment (tactical systems, multiple sensor-data fusion configurations) including in cyber- contested environments.
- Be interoperable with existing standards, where relevant, including NATO standards.
- Offer a modular and flexible design to ease the integration of new sensors and effectors (to ensure high scalability in terms of integration with existing or new sensors, effectors and subsystems)

Expected impact

It is expected that the outcome should:

- Strengthen the European defence technological and industrial base (EDTIB) on technologies related to unmanned systems, autonomy and the system-of-systems infrastructure needed to demonstrate situational awareness related to moving underwater threats.
- Identify specific research topics and generate knowledge to fill capability gaps in underwater threat assessment.
- Contribute to the interoperability and future capabilities of European forces in the area of underwater communication, detection, and monitoring of moving targets.