EDF-2022-RA-SPACE-RSS: Responsive space system

Budget: The Union is considering a contribution of up to EUR 20 000 000 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

The general objective of this research topic is to pave the way towards a future European responsive space system able to place small satellites in various types of orbits within a short notice in order to address specific operational needs, including tactical ones, and capability gaps stemming from shortage, failures and damages of existing space assets. This is particularly relevant in the field of intelligence, surveillance and reconnaissance (ISR) and satellite communication (SATCOM) where space assets have to be continuously operational and available to monitor and react to risks and events.

Such a responsive space system will enhance the resilience and autonomy of the Member States, Norway and of the European Union in the fields of 'access to space' and 'space capabilities for defence applications.

Specific objective

The specific objective of this topic is to define the concept of operations (CONOPS) of such a responsive space system and to identify and compare suitable and affordable architectures and solutions for the end-to-end system. In order to be able to provide mission critical responsiveness in terms of reconstitution, replenishment or augmentation of space assets, the responsive solutions need to be considered within a broader space defence ecosystem. In this respect, the multiple logistical challenges required by an end-to-end system that needs to operate at a tactical pace should also be taken into account.

Scope and types of activities

Scope

Project proposals must address collaborative defence research on the CONOPS and architecture of a responsive space system composed of a launch infrastructure (including fixed sites and/or mobile carriers), launch vehicles and spacecraft (satellite platforms and payloads) concepts as well as the ground segments and stations needed to operate the launcher and the satellite/payload. Project proposals must consider various options for each component of the system based on existing solutions, adapted solutions and/or new developments. In particular, terrestrial, maritime or airborne launch solutions must be considered.

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 (optiona
(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 (optiona
(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 (optiona
(e)	**System prototyping** of a defence product, tangible or intangible component or technology	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 following tasks must be performed as part of the mandatory activities (studies) of the project:

- consolidation of CONOPS from end-users, from user request for launch and preparation of the launch to ground and space segment interaction during launch and orbital phases;
- identification of main mission use cases for the responsive space system;
- preliminary analysis of the applicable regulatory framework (*e.g.,* compliance with NOTAM[7]/NOTMAR[8] requirements, launch security and safety requirements including stage re-entry, mission abort…);
- definition of the overall conceptual architecture for the end-to-end system and associated high level requirements; the system must include the following subsystems:
    - the launch infrastructure ensuring the purposes of launch preparation, launch pad and launch range (including fixed sites and/or mobile

carriers);

- the launch vehicle (rocket);
- the spacecraft composed of satellite platforms and of a family of sensors dedicated to missions;
- ground segments for the launcher, the spacecraft, including fixed/mobile ground stations for space data reception and the necessary means of encryption;

- identification of high-level requirements for the launch infrastructure and of suitable launch zones to launch terrestrial, maritime or airborne systems on short notice:
  - identification of suitable starting points (where the carrier departs) and launch areas (where the launch vehicle departs). Starting points must consider terrestrial, maritime or airborne mobile carriers;
  - this must include an overview and comparison of all existing and new planned launch sites having assembly, integration and test (AIT) and storage facilities and possibility to host mobile carriers in the EU or associated countries with their individual pros and cons (e.g. vertical, horizontal, maritime launch and airborne launch concepts; safety und ecological implications; suitability for one or more launch providers; reachability by truck, airplane, train;; reachable orbits; security measures to handle defence systems);
  - this task must consider phases from pre-flight to mission preparation and execution (including management of prepositioned payloads, propellant loading systems, etc.);
- identification of high-level requirements for the launch vehicle:
  - including volume under fairing, standardization requirements (including fairing interface), propulsion type, injection precision and required deltaV, operational life expectancy;
  - identification of high-level requirements for the spacecraft:
  - types and related performances (minimum standards);
  - standardisation, affordability and modularity/flexibility should be part of the analysis;
  - ability to be merged with the orbital upper stage should be looked at;

[7] Notice to air missions.
[8] Notice to mariners.

- identification of high-level requirements and definition for the ground segments and stations needed to operate the launcher and the satellite mission (platform and payload);
    - this task should include analysis of security requirements (encryption);
    - this task should also include a preliminary analysis of the sharing and booking mechanism for the system;

- identification and analysis of existing solutions able to meet the requirements and of needs for adaptations or for new research and development actions with their associated roadmap;
- costs vs benefits analysis (informed by CONOPS and architecture definitions) of the different options identified;
    - comparison of the proposed options in terms of costs / coverage of use cases and associated performances / safety constraints / logistics constraints / other implementation constraints / potential of evolution (e.g., reachable orbits, increased mass…);
    - the analysis must take into account the lifecycle cost including launch infrastructure, launch vehicle, spacecraft (satellite platforms and payloads), ground segments, including all required ground facilities for prepositioned payloads, pre-flight operations including propellant loading, cryogenic (if needed) storage solutions, safety storage facilities for solid, hybrid or liquid propulsion, end-to-end maintenance, repair and operations;
    - the analysis must also take into account the logistical aspects and include preliminary technical and logistical trade-offs between propulsion solutions;
- preliminary requirements review (PRR) guided by the end-users (from Members States and Norway).

The following tasks may be performed as part of optional activities (design) of the project:

- simulation of the achievable responsiveness (end-to-end performances) of selected options for selected mission use cases / scenarios;
- preliminary design of selected sub-systems (to be proposed by the applicants).

Functional requirements

The responsive space system is expected to meet the following requirements:

- time between request for launch and positioning into orbit should be less than 72 hours including flight range safety measures. Time to operational data delivery can be shorter, depending on the precision of orbit injection, the type of orbital propulsion, the type of sensors and related calibration in space;
- ability to reach any low earth orbital plane, from equatorial to sun-synchronous polar

orbits, while minimizing the operating and logistical constraints (operable from various types of areas);

- ability to place a satellite between 20 kg and 200 kg into an orbit of at least 400 km.

Expected impact

The action should produce the following expected impacts:

- set the basis for the development of a responsive space capability not yet available at European level;
- creation of a sovereign supply chain in Europe for defence capabilities in the domain of responsive space systems;
- leveraging the European defence technological and industrial base in the domains of launch infrastructure (including mobile carriers), rockets and satellite platforms and sensors;
- extension of EU launch solutions portfolio and strengthening of the EU autonomy in this field.