

HORIZON-CL4-2021-SPACE-01-12: Future space ecosystems: on-orbit operations, new system concepts

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 1.00 and 2.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 6.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	The conditions are described in General Annex B. The following exceptions apply: Some activities, resulting from this topic, may involve using classified background and/or producing of security sensitive results (EUCI and SEN). Please refer to the related provisions in section B Security — EU classified and sensitive information of the General Annexes.
<i>Technology Readiness Level</i>	Activities addressing area 1 of the call topic are expected to achieve TRL5-6 by the end of the project – see General Annex B.

Expected Outcome: Enable the industrialisation and new services in space by intelligent solutions and concepts, exploiting synergies with terrestrial sectors and cultivating an *AppStore* and *Open-Architecture* mentality.

Therefore, automation, robotics and artificial intelligence (AI) especially in combination with standardisation, modularisation and digitalisation are key enablers, improving space systems and satellites’ flexibility and cost-efficiency, increasing sustainability and accessibility, introducing mass-customisation and cooperative design as well as simplifying operations.

Each project is expected to contribute to one or several of the following outcomes:

- A future space ecosystem, fostering the industrialisation and business in space as well as supporting scientifically meaningful missions by using synergies with terrestrial sectors, building on spacecraft modularity, simplifying operations and make *plug-and-play* modules more common as well as enabling on-orbit services such as maintenance, assembly, manufacturing, re-configuration, recycling, logistics, warehousing, etc.
- Game-changing technologies, tools and processes enhancing on-orbit servicing applications and contribute to the protection of the in-space future ecosystem (e.g. debris mitigation).

- A paradigm shift towards sustainable, highly automated, flexible and economical viable space infrastructure, to maximise commercial opportunities in space and on Earth.

This will contribute to, in the medium to long term, developing, deploying global space-based services and contribute to fostering the EU's space sector competitiveness, as stated in the expected impact of this destination.

Scope: The areas of R&I, which need to be addressed to tackle the above expected outcomes are:

1) R&I on new scalable satellite platform concepts and building blocks increasing the degree of satellite modularisation. Aiming at intelligent, adaptable and maintainable systems with *plug-and-play* compartmentalised functionalities (modules) that will introduce both, on-orbit re-configuration and re-use/re-cycling of spacecraft parts fostering debris mitigation, as well as increased system redundancy, inherently. The approach should consider an innovative, scalable and adaptive framework concept for a '*European construction kit for satellite systems and applications*', following the *AppStore* approach and fostering development of compartmentalised functionalities (modules) for satellite systems independently from mission. The framework should address the needs from building block developers as well as from end-users. As one result, functional satellite modules (Orbital Replaceable Units to deliver new/enhanced functionality) should be developed (TRL 5-6) to upgrade the satellite platform of the orbital demonstration mission¹ by using pre-existing standard interfaces² (*plug-and-play* concept). The module design should support the integration of different pre-existing standard interfaces^{1,3}. Further reference is given in a technical guidance document applicable to this area³.

2) R&I on new on-orbit services concepts concentrating on a next generation of potential business cases (e.g. satellite recycling, transfer services, logistics, warehousing, etc.) contributing to a sustainable space infrastructure and in-space ecosystem development. Work should include, but not be limited to, market & trend analyses, design of mission and system architecture, and feasibility studies.

3) R&I to identify, develop and implement AI and industry 4.0 means (e.g. virtual design, digital twins, virtual testing) in order to attain *Rapid Development, Production and Assembly Integration and Testing (AIT)* processes in satellite life cycle.

Proposals should explore relevant and promising solutions derived in Horizon 2020 activities, especially project results from the Strategic Research Clusters *Space Robotics Technologies*⁴ and *Electric Propulsion*⁵.

¹ To be developed under topic HORIZON-CL4-2022-SPACE-01-11

² Multi-functional interface for OOS applications providing at least transfer of mechanical loads, power and data, (e.g. HOTDOCK, iSSI or SIROM)

³ Published on the EU funding and tenders portal (<https://ec.europa.eu/info/funding-tenders/opportunities/portal>)

⁴ www.h2020-peraspera.eu

⁵ www.epic-src.eu

A proposal may address more than one area but must indicate the main area addressed, and is expected to promote cooperation between different actors (industry, SMEs and research institutions) and consider opportunities to quickly turn technological innovation into commercial space usage.

To ensure a balanced portfolio covering the three areas described above, grants will be awarded to applications not only in order of ranking but at least also to one project that is the highest ranked within each area, provided that the applications attain all thresholds.

In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

Foster competitiveness of space systems

HORIZON-CL4-2022-SPACE-01-11: Future space ecosystems: on-orbit operations, preparation of orbital demonstration mission

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 20.00 and 26.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 26.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Admissibility conditions</i>	The conditions are described in General Annex A. The following exceptions apply: The page limit of the application is 70 pages.
<i>Eligibility conditions</i>	The conditions are described in General Annex B. The following exceptions apply: Some activities, resulting from this topic, may involve using classified background and/or producing of security sensitive results (EUCI and SEN). Please refer to the related provisions in section B Security — EU classified and sensitive information of the General Annexes.
<i>Technology Readiness Level</i>	Activities are expected to achieve technology maturation up to TRL6 by the end of the project – see General Annex B.

Expected Outcome: The expected outcomes of this topic is to prepare a European pioneering, high-impact but low-cost orbital demonstration mission for On-Orbit Servicing (OOS) in 2025-2026 period that will demonstrate and showcase European know-how, support market

generation, open new business opportunities, foster international cooperation and deliver a long-lasting impact in the future space ecosystem.

Projects should in particular contribute to prepare and showcase a future space ecosystem fostering the EU's space sector competitiveness, as stated in the expected impact of this destination. Further building on modularity and enabling on-orbit servicing, assembly, manufacturing and recycling, and facilitate a smooth transition between the short-term market needs and future commercial possibilities while respecting the protection of the in-space ecosystem.

Scope: R&I on phase B2-C mission study⁶ and target-oriented technology maturation (TRL 6) to prepare a low cost orbital demonstration mission integrating robotic and autonomy technologies and technical building blocks with high-impact on future commercial services applying and enhancing the European Operations Framework for OOS. Technology maturation should aim at risk reduction of the intended pioneering orbital demonstration mission as well as at raise of confidence on OOS applications in general. The designed satellite platform should be compatible with a functional upgrade later in Phase D enabled by functional satellite modules (Orbital Replaceable Units to deliver new/enhanced functionality), developed outside this topic and able to be connected to the platform using a pre-existing standard interface⁷ (*plug-and-play* concept).

R&I activities related to technology maturation in the area of GNC, autonomous localization and termination, modern TM/TC data handling, low-cost and modular avionics, automated rendezvous and capturing technologies as well as avionics and test-beds are also addressed in topic HORIZON-CL4-2021-SPACE-01-23.

Work done on Space Robotics including the European Operations Framework (EOF) in Horizon 2020, and especially on the phase A-B1 mission studies to be launched in 2020, should be exploited where possible. The EOF guidelines⁸ should be applied to and enhanced by the orbital demonstration mission.

Further reference is given in a technical guidance document⁹. Technical documents of the previous studies in the H2020 Strategic Research Cluster *Space Robotics Technologies*¹⁰ are available on the PERASPERA website.

In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

⁶ according to ECSS-M-ST-10C

⁷ Multi-functional interface for OOS applications providing at least transfer of mechanical loads, power and data (e.g. HOTDOCK, iSSI or SIROM)

⁸ www.h2020-peraspera.eu

⁹ Published on the EU funding and tenders portal (<https://ec.europa.eu/info/funding-tenders/opportunities/portal>)

¹⁰ www.h2020-peraspera.eu