



ARTES 4.0 Generic Programme Line Business Applications - Space Solutions

“Commercial Applications of Space-Enabled Robotics – Smart Cities and Infrastructure”

THEMATIC CALL FOR PROPOSALS

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Table of ACRONYMS

AI	Artificial Intelligence
APQ	Activity Pitch Questionnaire
AoF	Authorisation of Funding
ARTES	Advanced Research in Telecommunications Systems
BASS	Business Applications and Space Solutions
DG	Director General
ESA	European Space Agency
FP	Full Proposal
IoT	Internet of Things
ML	Machine Learning
OP	Outline Proposal
OSIP	Open Space Innovation Platform
SME	Small and Medium sized Enterprise
TIA	Directorate of Telecommunications and Integrated Applications

1. OVERVIEW

This document presents an overview of the “Commercial Applications of Space-Enabled Robotics”, under the 1st thematic area “Smart Cities and Infrastructure”, thematic call for proposals issued under the ARTES BASS, 5G and 4S programme lines. The call offers the opportunity to companies to bring forward their business propositions, which shall leverage on space and advanced digital technologies for delivering sustainable solutions.

2. BACKGROUND AND RATIONALE

The fields of robotics, drone technologies and autonomous systems have witnessed tremendous growth over the preceding decades driven by parallel technological advancements and heightened demand across various sectors. Progress made in domains such as artificial intelligence and its integration in said systems have enhanced their capabilities in terms of perception, decision-making and adaptation to dynamic environments. These capacities are enabling autonomous systems to optimise their performance and achieve higher degrees of autonomy across varied operational contexts.

Developments in autonomous vehicles (across land, sea, and air) continue to progress aided by advancements in sensing technologies, computer vision and A.I. algorithms, to the extent that self-driving taxis currently roam the streets of a small number of global metropolises (and counting). Industry 4.0 proponents have established robotics as a core component of a suite of technologies and paradigms - including Internet-of-Things, big data analytics, and cloud computing – critical to enable the factories of the future, citing these as essential to achieving enhanced quality, productivity, safety, flexibility, and reduced costs. There is a drive towards ensuring seamless coalescence between robotic systems and humans in shared environments – so-called collaborative robotics or ‘cobots’ - spurring solutions for reliable detection of human presence and safe interaction, such that we work together harmoniously into the future. Drone technologies are benefitting from incremental advances in battery life, autonomy, and sensor miniaturisation enabling them to complete missions for aerial imaging, mapping, surveillance, and deliveries, across industries that may not have been tenable prior.

The space industry is also undergoing a renaissance of sorts, and with this, new satellite services have emerged enabling new applications and synergies with complementary technologies, such as robotics, drones, and autonomous vehicles. Whether satellite communications to extend the reach of such systems to remote regions, satellite positioning to support navigation, or earth observation data for situational awareness, or otherwise.

The aim of this initiative is to support companies in creating commercially sustainable solutions in which satellite technology and data is used to support robotics and autonomous systems in addressing various market and user needs. ‘Robotics’ is here defined to include physical robots, autonomous drones, machines and vehicles, and precursory solutions or those that enable these (e.g. perception and navigation systems

for autonomous vehicle services, connectivity solutions to enable tele-operated robotics, etc).

In relation to smart cities and infrastructure, robotics and/or drones could support the development of physical or “hard” infrastructure through construction site surveys, inspection, progress monitoring and support to operations. More ambitiously, autonomous and semi-autonomous construction robotics and vehicles (bulldozers, excavators, graders, pilers, pavers, etc) may offer solutions for preparation of land and foundations for further construction, and more sophisticated tasks.

Robotics and drones are already becoming a mainstay for physical infrastructure inspection (such as bridges, road, etc) to assess safety and preservation, however there are many opportunities to extend these capabilities in terms of ability, autonomy, and the scope of sites that they can safely navigate.

Broader smart city solutions may involve robotics deployed for waste collection and street cleaning, autonomous deliveries, entertainment, social support, and tourism purposes, or other relevant domains as identified by the Bidder. This may be by way of autonomous shuttle services in tourist destinations, waste collection by uncrewed surface vehicles via waterways, drone deliveries, and beyond.

3. OBJECTIVES OF THE CALL

This Call for Proposals invites proposals for feasibility studies and demonstration projects for services that combine the use of satellite technologies and robotics for downstream services.

Downstream services here refers to activities involving the utilisation of data and services provided by space assets. This component includes satellite communication services, satellite earth observation data, and satellite PNT (positioning, navigation, and timing) services, and other applications that leverage space-based technologies for various industries on Earth. Downstream activities focus on delivering value and insights derived from space-based assets to end-users and businesses.

‘Robotics’ is here defined to include physical robots, autonomous drones, machines and vehicles, and precursory solutions or those that enable these (e.g. perception and navigation systems for autonomous vehicle services, connectivity solutions to enable tele-operated robotics...).

The main objectives of the call are to:

- Enable and cultivate the study, development, and demonstration of innovative¹ services at the intersection of space-based services and robotic systems, to create an added-value in various industries. This made possible by integrating any of

¹ Innovation could reflect the business model, technology, operational context, or a combination thereof.

satellite communications, earth observation and/or positioning at the system or service level (i.e., integrated with the robotic system directly, or supporting the overall service).

- Utilise this combination of advanced technologies to improve industrial efficiency, productivity, operational safety, competitiveness, and generally tackle challenges in industry that could not otherwise be addressed without the unique complementarity of these technologies.
- Support the adoption of satellite technology/data into robotic systems in the context of operational services such that the emergent design, development, and implementation constraints are identified, evaluated, and mitigated, to enable more rapid realisation and scaling-up of such services on Earth, into the future.
- Enable the creation of new markets and the establishment of novel business models permitted by this combination of technologies in the chosen sectors.

The objectives of this specific subtheme are to:

- In accordance with the above, enhance the liveability, safety, sustainability, operational efficiency, and overall quality of life in cities through the establishment of services exploiting the benefits of robotic systems and satellite services.
- Enhance the efficiency and safety of physical infrastructure development and operations.

4. SPACE ASSETS

Satellite technologies and data have a significant role to play within prospective services:

- **Satellite positioning** can provide coarse to high accuracy positioning information to robots, vehicles, machines and drones operating in outdoor spaces. This can be used for navigation, geo- and timestamping of collected data, time-synchronisation of networked machines, and/or determination of speed and heading. Satellite positioning could be combined with inertial and alternative positioning techniques to support indoor-outdoor seamless localisation and marine robotics. Augmentation of GNSS can offer higher positioning accuracies for certain use-cases via solutions such as Galileo HAS (High Accuracy Service), RTK (Real-Time Kinematic) solutions, or otherwise, with the selection dependent on the service requirements.
- **Satellite communications** provides data, video and voice communications and may add value to applications implemented in the following service provision scenarios:
 - Environments that have inadequate, unreliable, compromised, or altogether absent mobile cellular connectivity.
 - Mobile services that operate across regions with varying cellular connectivity quality (good in certain areas, poor in others) and require continuous coverage and availability.
 - Services that have high security, robustness and resilience requirements may benefit from satellite communications for redundancy in compromised or unforeseen circumstances.
 - These may be pertinent for drone operations in rural areas, autonomous vehicles, or operations of robotics in any of the above given circumstances.

New developments in satellite communications may also be exploited, such as Low-Earth Orbit (LEO) Broadband satellite constellations, to enable certain services with demanding performance or cost constraints.

- **Satellite Earth Observation** - it is expected that satellite earth observation could support robotics solutions at the service level i.e., providing complementary or enabling datasets to support the activities of the robots. This could be through mapping data to support the navigation of the robot, or collection of datasets that complement those collected by the robot. Satellite earth observation data could refer to air quality measurements, thermal heat signatures, optical, radar, meteorology, or combinations thereof. This could manifest as use of satellites followed by drones or robotics in a “find and refine”² approach, or otherwise.
- **Spaceflight Technology Spin-Outs** - applications of robotics developed for use in space (and other astronomical objects) that also have commercial applications on Earth, i.e. Spaceflight Spin-Outs, are also considered eligible. This could relate to robotics developed for space, tele-robotic solutions and algorithms (perception, planning, control...) developed for autonomy of space robotics, or otherwise.

In all cases, the role of space technology and/or data in the service should be justified in comparison to non-space alternatives.

5. SCOPE OF THE CALL

The proposals under this Call for Proposal shall address the Smart Cities and Infrastructure domain with innovative user-driven downstream services which rely on the combination of satellite technology/data (any of those mentioned above) and robotic systems.

The Bidder shall either address the use cases included in the Annexes ([available on the website](#)) or address other use cases and requirements related to Smart Cities and Infrastructure provided by other customers / users directly involved by the Bidder. In the latter case, support of those potential customers shall be evidenced in letters of interest to be attached to the Outline Proposal (the second step in the application process).

The service provider shall be identified and be part of the bidding team to ensure the commercial operational roll-out of the proposed service following completion of a demonstration project.

This Call for Proposals covers two types of activities:

1. **Feasibility Studies**, which provide the preparatory framework to identify, analyse and define new potentially sustainable services. The applications and/or services covered by the proposed Feasibility Studies must:
 - Be customer/user driven and present a strong sustainability potential.

² Find and Refine” - a commonly used approach in remote sensing and geospatial analysis, where initial observations are made using coarse resolution data or sensors, and then higher resolution data or sensors are used to refine and confirm the results. The initial observations serve as a guide to focus the more detailed analysis, leading to a more accurate understanding of the phenomenon being observed.

- Propose a service demonstrating the benefits of the utilisation of integrated space assets.
 - Include a viability analysis.
 - Aim to evolve the targeted applications and services to marketability and operational roll-out, potentially through a Demonstration Project after successful completion of the feasibility study.
2. **Demonstration Projects**, dedicated to the implementation and demonstration of pre-operational services. The applications and/or services covered by the proposed Demonstration Projects must:
- Be customer/user driven (including user involvement and active participation in the project).
 - Propose a service demonstrating the benefits from the utilisation of space assets with clear potential to become commercially sustainable.
 - Provide a measurable socio-economic impact.
 - The Bidder shall involve in the project representatives from user communities, which shall take part in the pilot.

6. PROCUREMENT APPROACH

The proposals submitted in reply to the call shall be implemented in the context of ESA BASS, 5G and 4S programme lines of ARTES in coordination with National Delegations.

The Bidder shall submit first an Activity Pitch Questionnaire, and following evaluation, may be invited to submit the Outline and Full Proposal. The Activity Pitch Questionnaire (APQ) template provided by ESA shall be used. This is considered as entry point for companies to submit their idea, providing a simplified and single point of access to the ESA ARTES framework.

The price of activities carried out in a given State are charged against the contribution of that State in the programme. A letter of Authorisation of Funding (AoF) from the relevant National Delegation is therefore required as part of the Full Proposal. The Bidder is however advised to inform the relevant National Delegation(s) when submitting the Pitch. The contact information of the National Delegates can be found here: [National Delegations | ESA Space Solutions](#)

The Agency will admit for evaluation only (Outline and Full) proposals from a bidding team composed of a company and/or organisation - be it as Prime or Subcontractor - residing in any of those states that subscribe to the Programme under which you wish to submit your proposal:

- I. **for the ARTES 4.0 BASS Generic Programme Line - Component A:** Business Applications. To date, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Sweden, Switzerland and the United Kingdom have subscribed.
- II. **for the ARTES 4.0 5G Strategic Programme Line:** Austria, Belgium, Finland,

Germany, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom and Canada have subscribed.

- III. **for the ARTES 4.0 4S Strategic Programme Line:** Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxemburg, The Netherlands, Norway, Poland, Portugal, Romania, Spain, Switzerland, the United Kingdom and Canada have subscribed.

7. PROCESS AND SCHEDULE

It is planned for the call for proposals to be opened on 7th March 2024 until 7th May 2024, 13:00 CET.

7.1. Timeline and Procedure

Bidders can respond to this thematic call by submission of a short Activity Pitch Questionnaire within the above timeframe. The timeline is illustrated below.

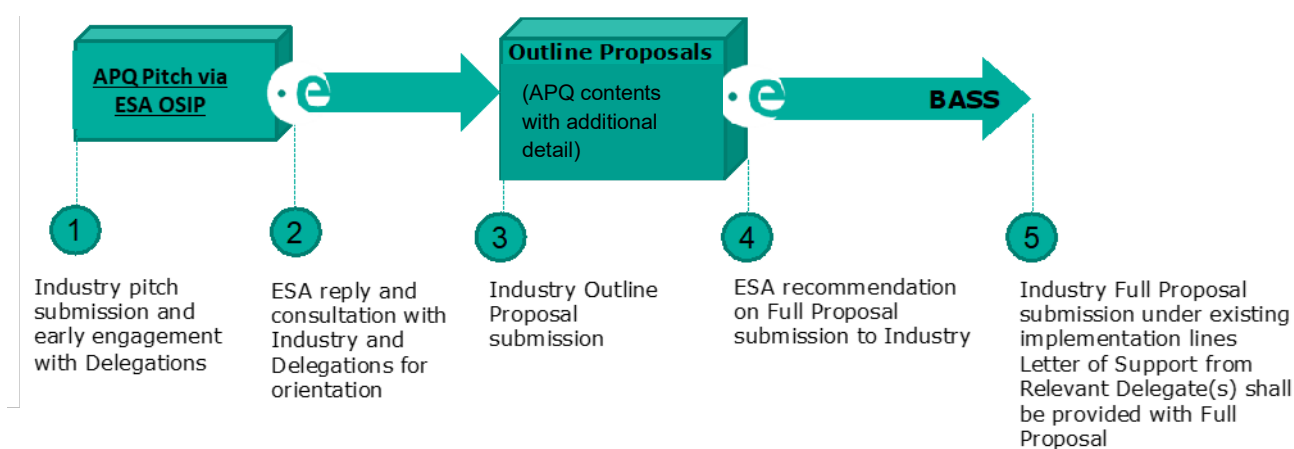


Figure 1: Procurement Approach

The Call is planned to be implemented according to the following stepwise approach:

In **Step 1**, the interested Bidders are requested to submit their proposal(s) based on a short Activity Pitch Questionnaire (APQ) template made available by ESA that can be downloaded from the Thematic Call website. The pitch should provide the initial idea of what the Bidder would like to propose, elaborated on the basis of the thematic areas and either the use cases proposed by ESA’s partners or others selected by the Bidder.

Should the bidder wish to cooperate with any of the listed partners in the annexes, they shall give to the Agency the authorisation to distribute the activity pitch questionnaire to these stakeholders by explicitly stating it in the Activity Pitch Questionnaire. Subject to such authorisation, the Agency will follow up distributing the APQ to the bidder’s authorised stakeholder(s) and liaise with them to facilitate interactions with the Bidder.

The Bidder shall not contact any of the stakeholders listed in the annexes on the webpage.

The Bidder shall NOT involve any of the stakeholders mentioned in the annexes in the bidding consortium neither as subcontractor nor as external service (including consultancy).

The completed Activity Pitch Questionnaire (APQ) shall be uploaded using the online web submitter, ESA's open space innovation platform (OSIP) in the channel named "[APQ for ARTES Downstream Business Applications](#)"

Multiple Pitches can be submitted.

It is strongly recommended that the interested Bidder liaises with the relevant ESA Member States Delegates from the beginning.

In **Step 2**, following an assessment of the Pitch by ESA, ESA will provide feedback to the company, aiming to provide a reply within 10 working days following the deadline for submission of the Pitch.

It is recognised that some interactions with the Bidder may be required and ESA may therefore consult with the Bidder and may offer support in providing further clarifications, aimed at better shaping the Outline Proposal(s). Dialogue sessions may be organised individually with potential partners prior to Step 3.

ESA might also consult, when necessary, with the relevant National Delegation(s) for orientation and will provide key information (e.g. title, cost, price, subcontractor) to the relevant National Delegation(s).

Subject to a positive evaluation of the Pitch and the Bidder having informed the National Delegation(s), the Bidder will be notified by ESA and invited to submit an Outline Proposal.

In **Step 3**, the Bidder will submit the Outline Proposal, based on a template provided by ESA, with letter(s) of interest from users/stakeholders. The Outline Proposal is expanding the Pitch with a more extensive level of details. The outline proposal will be submitted on the OSIP platform under the channel "[Outline Proposal for ARTES Downstream Business Applications – Feasibility Studies/Demonstration Projects](#)".

In **Step 4**, subject to a positive assessment from ESA and in-principle support from the National Delegations, the Bidder will be invited to submit a Full Proposal on ESA-STAR in accordance with BASS programme line.

In **Step 5**, the Bidder will submit a Full Proposal with the Authorisation of Funding (AoF) from the relevant National Delegation(s). Following a positive assessment by ESA the proposed activity will be approved for implementation.

7.2. Evaluation Criteria

The evaluation process is non-competitive, as each proposal will be assessed individually on its own merits, according to the evaluation criteria applicable for [CALL FOR PROPOSALS FOR DOWNSTREAM APPLICATIONS IN ARTES 4.0](#) (esa star ref.: 1-10494).

More information for the assessment of the APQ and outline proposal stages can be found

on the OSIP page [“APQ for ARTES Downstream Business Applications”](#).

More information on the evaluation criteria for the final proposals can be found within the document “Appendix 1 to AO/1-10494/20/NL/CLP (Issue 2.2)” which can be found on ESA-STAR at the prior link.

8. GENERAL CONDITIONS

The submissions and all correspondence relating to it shall be in English.

The tender shall not contain any Classified Information, whether in the Pitch, Outline Proposal or in the Full Proposal.

To avoid any confusion with Classified security markings, the unclassified protective marking used by the Tenderer in the proposal shall not contain the terms: "Restricted", "Confidential", or "Secret".

However, should the Tenderer consider necessary to include Classified Information in the tender, the Tenderer shall inform beforehand the ESA Security Officer.

The Tenderers are informed that Classified Information can be shared with ESA only in compliance with the Project Security Instruction (PSI) duly established by the Agency beforehand and subject to the approval by the ESA Member States.

The Agency will treat commercially sensitive or proprietary information confidentially and solely for the purpose of the assessment of the response.

Expenses incurred in the preparation and dispatch of the response to the announcement will not be reimbursed. This includes any expenses connected with a potential dialogue phase.

The announcement does not bind the Agency in any way to place a contract. The Agency reserves the right to issue amendments to the announcement.