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Commercialisation Opportunities in European Ground Segment

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Abstract

The European Space Agency, ESA, has conducted in 2023-2024 a series of coordinated activates to assess the potential of commercialisation opportunities in European Ground Segment. This assessment has been based on the results of targeted surveys, workshop and industry days, market analysis, and an open call for ideas to European companies. The survey and the call for ideas has been open to all ESA member state companies. They attracted more than 60 participants and 51 concrete business case proposals. The participating companies included start-ups, SMEs and large system integrators. New Space companies participated to the call alongside with established space industry. The proposals covered the full spectrum of products, services, and end-to-end solutions. This paper elaborates on the details of the steps of this journey, the main findings and a mapping of the capabilities in each of the ground segment domains to commercial business opportunities. It also provides an outline of the recommendations and the programmatic preparations for unleashing the full potential of European industry in ground segment domain.

Keywords: European Space Agency, Commercialisation, Ground Segment, New Space, Advancing Solar System Internet and Ground (ASSIGN)

1. Introduction

The Ground Segment is an essential part of every space mission. Without Ground, there is no space mission; no data, products or services of a space system can be provided without the functions of a ground segment. The main elements of ground segment can be grouped in the following domains:

- Ground station, network and communication systems
- Flight dynamics and mission analysis systems
- Mission applications and data systems (Mission planning, simulator, Mission Control System, data analytics and product generation, archives and data dissemination systems)
- Mission operations facilities (including data canters and IT infrastructure)
- Mission Operations

Even for a single satellite mission, the ground segment is typically composed of a relatively large number of complex hardware and software systems. The trend towards constellations, more security and autonomy adds to the complexity and the multitude of the involved systems.

The ground segment of most ESA missions is based on reuse of generic multi-mission ESA Mission Operation Infrastructure. This multi-mission infrastructure has been built from the outset with reuse and standardisation in its DNA. The design of its systems and the software code are available in a loyalty-free licensing scheme to European industry. In the recent years ESA has moved towards a community licencing model, which makes the solutions even more accessible to its member states industry for reuse. This industrial policy, licensing scheme, strong focus on open architectures, multi-mission design and interoperability have led to a lively and large ecosystem of European companies in each of the domains of the ground segment. The well-known commercial success stories of European industry, offering world-wide competitive commercial solutions and services, which are based on reuse of elements of the ESA Mission Operation Infrastructure are a testimony to this fact.

The development of the Ground Segment of most ESA missions and the management and evolution of the ESA Mission Operations Infrastructure are entrusted to ESA directorate of Operations. Jointly with the ESA directorate of Commercialisation, Industry & Procurement, we have completed in 2023 and 2024 a series of activities to assess the commercialisation opportunities in Ground Segment. The objective of this assessment has been to identify how to

unleash the full potential of European industry in this domain and where and how ESA shall adapt to the rapidly changing landscape of New Space and emergence of commercial players. Fig. 1 depicts the steps of this assessment journey, starting with an online survey. 60 companies participated to the online survey and voiced a clear demand for support from ESA in their commercialisation roadmaps. Based on the survey results multiple workshops were organised, focused on selected domains of ground segment. A dedicated workshop at European Space Operation Centre facilitated the direct dialog with European New Space companies, active in Ground Segment. To deepen the assessment, ESA contracted the Northern Sky Research (NSR) to perform an independent deep-dive market analysis. with the companies. The independent market analysis of NSR confirmed the trends observed from the results of the initial survey. It identified the areas of Ground Segment with highest demand and most opportunities for commercialisation. It also provided an overview of the needs of the companies for support from ESA in each domain.

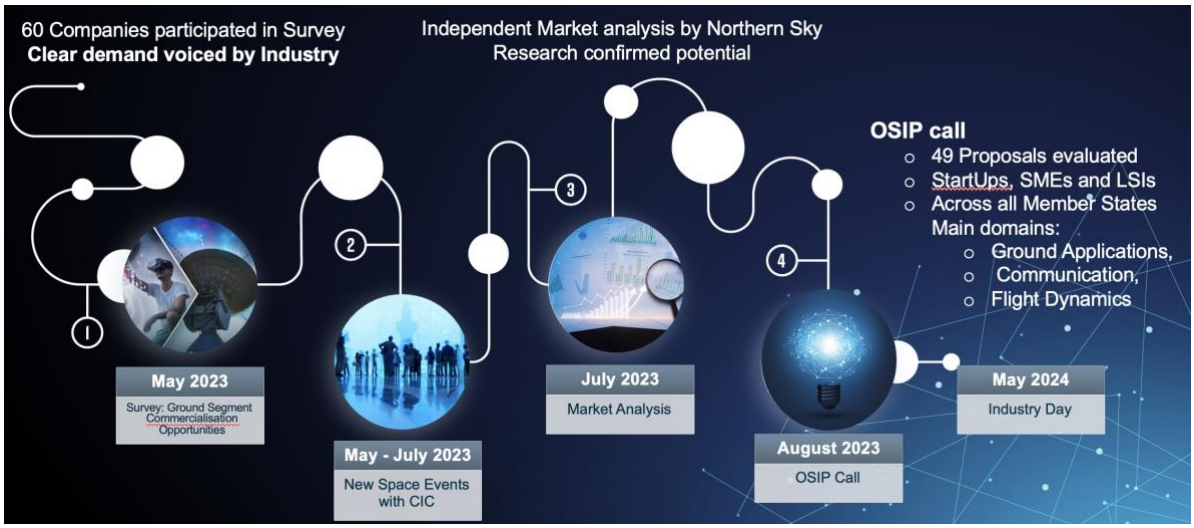
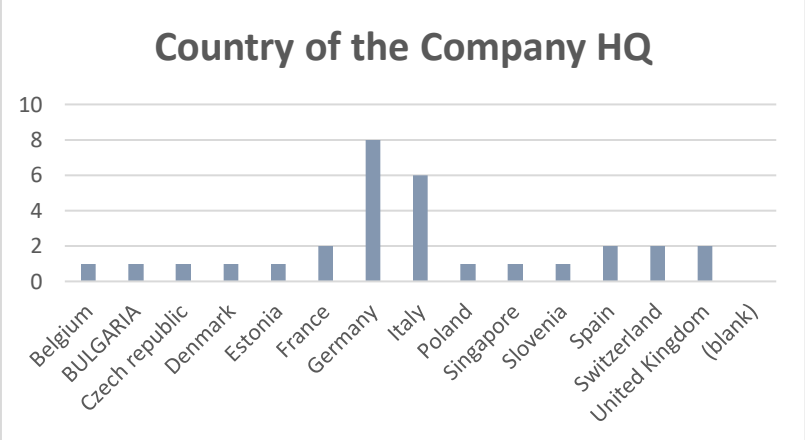


Fig. 1. The Assessment Journey for Commercialisation Opportunities in European Ground Segment

Building on these results, an open call for ideas was launched in August 2023. It attracted 51 concrete business case proposals from start-ups, SMEs and large system integrators. New Space companies participated to the call alongside with established space industry. In a follow up industry day, the participating companies have engaged with ESA team of experts, further exploring the business case evaluation in dedicated one-to-one sessions. An overview of the proposals, the evaluation approach and results are provided below.

2. Overview of Proposals

The proposals cover the full spectrum of product, services, and end-to-end solutions. As part of the proposals the companies have formulated their request for ESA support, in form of providing funding, software, data, expertise or access to facilities. The distribution of companies over ESA member states and the



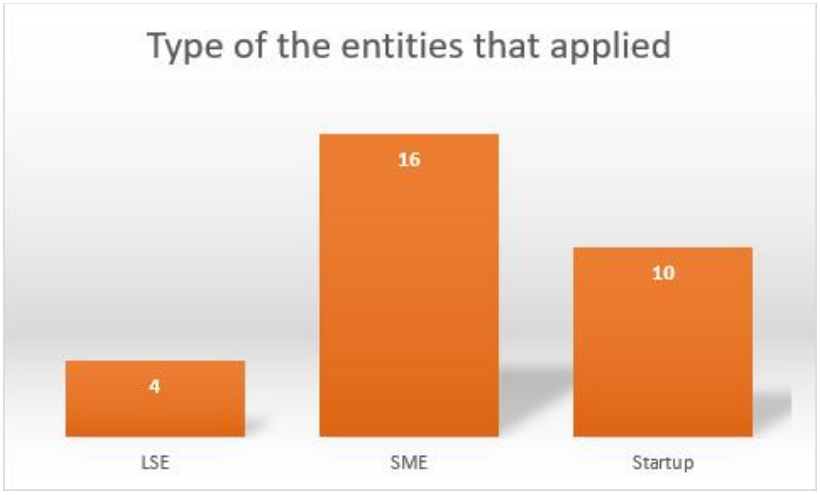


Fig. 2. Overview of the proposals per country and company type

Submitted proposals are mapped to one of the following categories of Ground Segment systems products and services:

- Ground Station and Communication
- Flight Dynamics and Mission Analysis
- Applications and Data Systems
- Mission Operations Facilities

No proposals were submitted in the domain of Mission Operation Execution nor in System Integration.

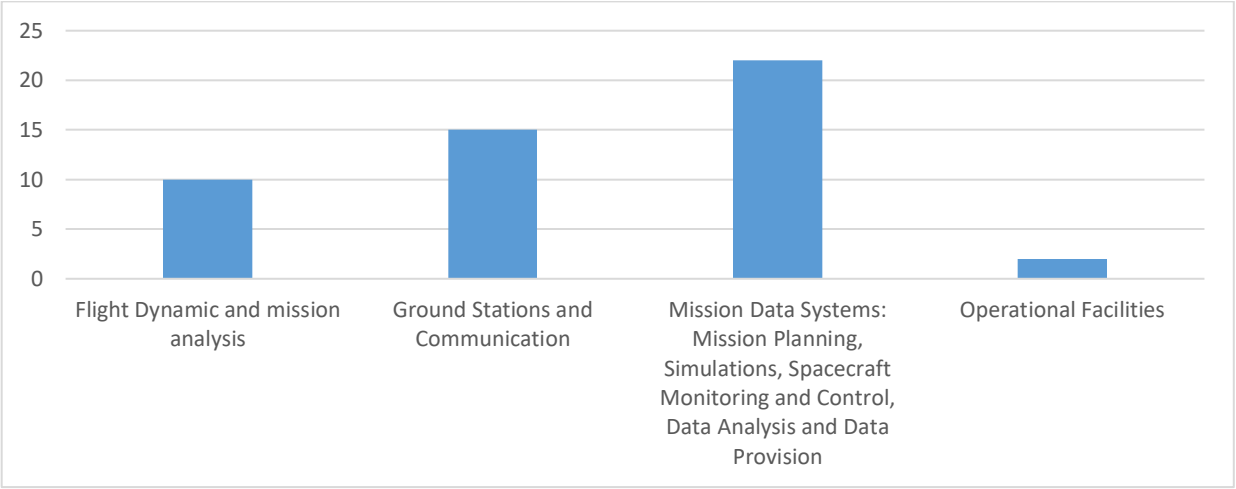


Fig.3 . Distribution of proposals per Ground Segment domain

3. Evaluation Approach

There has been no dedicated funding allocated to the open call for ideas. The evaluation has accordingly not been in the sense of a competition and selection of winning proposals. The objective has been much more to take the pulse of the industry in the ground segment domain and to map the landscape of commercial opportunities and identify how ESA can help the industry through existing programs of the Agency. The evaluation has included the identification of the best fit for the ESA role in accordance to the ESA commercialisation Strategy

- ESA as Customer
- ESA as Partner
- ESA as Enabler

Following criteria have been used for the evaluation: technical assessment, commercial assessment, competitive offerings, related ESA assets and expertise, ESA Role as Anchor Customer, Partner or Enabler.

4. Evaluation Results

The main findings can be summarised as

- Most proposals include an element of development
- Most proposals are extension of existing products and services, to address the specific needs of a new markets
- Most proposals have time-to-market as a key factor for success
- The majority of the proposals are in the software and applications domain.
- The time horizon of most proposals is not compatible with the typical ESA technology maturation path (TRL Scala climb).
- In many cases the proposed approach of New Space is to close the gap from a prototype to the market product in a very short time frame
- While ESA as Anchor Customer (hence access to funding source) is one of the main requests for success, access to ESA expertise, software and data are indicated as key success factors for proposals.

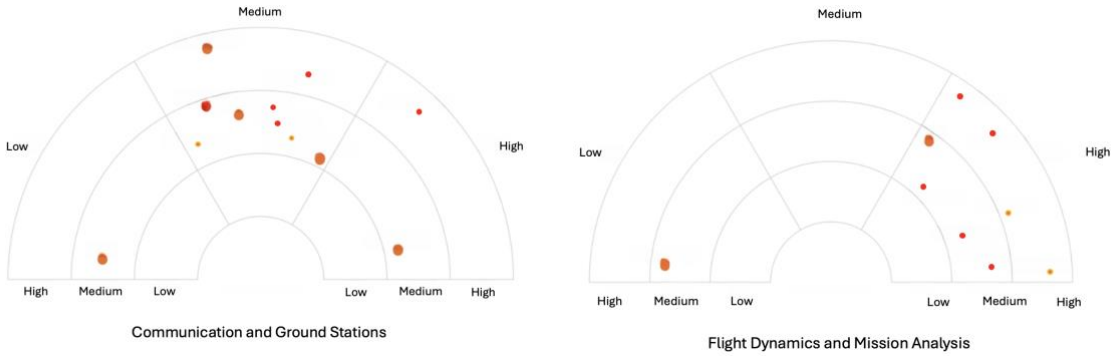


Fig.4. Results of the technical and commercial assessment of the proposals

5. Targeted Capabilities and Needs

While maintain confidentiality, without providing the details of each proposal, the target services and solutions in

5.1. Ground Station and Communication: Frequency and Timing technologies and instrumentation; Automatic maintenance and anomaly detection for ground station systems; Ground station topologies for LEO applications; Ground station automation for satellite constellations; Environmental sustainability for ground stations; Ground station services for Lunar applications; New communication concepts and protocols for enhanced space-to-ground interface.

5.2. Applications and Data Systems: Ground Segment systems as a service, often targeting small missions or payloads to enable simple and rapid provision of space systems monitoring and control, but also extension toward non-space domains, Autonomy and Automation of ground segment, Enhanced mission planning solutions, Enhanced Operations through Data Analytics, typically via AI analysis of time series data to detect unseen issues and predict future behaviour. The technical solutions fell into 3 broad categories:

- Modern software technologies applied to classical problems.
- Enhancement of existing solutions.
- Adoption of existing solutions, or development of new solutions around cloud native design concepts
- Use of Data Science technology and AI/ML to provide new or deeper insights into operational concerns

5.3. Flight Dynamics and Mission Analysis: Commercial application development based on ESA software infrastructure, Validation of commercially developed systems using ESA tools as a reference, Access to ESA data and expertise for system development, validation, and operations, Access to ESA mission operations e.g. at mission end of life, to build commercial operations expertise.

5.4. Mission Operations Facilities: Only two proposals were submitted in this domain. One is focused on the launchers domain. The other proposal from aims at operational services to New Space.

6. Conclusions

The call for proposals attracted significant attention and participation from European New Space and established companies in ground segment domain. This is despite the limited effort, invested in preparation and promotion of the call (e.g. publication and announcement on ESA Commercialisation Gateway portal [RD1] and via LinkedIn posts). The submitted proposals span over all areas of Ground Segment systems and services. Most of the proposals have been evaluated to be technically sound with a positive commercial potential. Most proposals contain an element of development, enhancement with new features or scaling. The evaluation of the proposals has pointed out that the transition from technology development, maturation and derisking to commercialisation does for many cases not follow the traditional concepts of respective ESA programmes. Time-to-market is an essential success factor for the majority of the proposals. The expectations and commercialisation timeline of the participating companies does often not fit with the lengthily and segregated processes of ESA technology programmes. This is in particular the case for New Space companies. Most proposals have a strong element of software and IT. This reflects the synergies between the New Space domain and the IT Startup mindset. Rapid time to market, DEVOPS, extremely fast transition from a prototype to a minimal viable product with continuous evolution to more enhanced and feature reach commercial solutions are typical characteristics. While ESA as an Anchor Customer (access to funding source) has been indicated often as a success factor, ESA assets such as software, data and expertise are equally requested as key success factors. The following recommendations are driven from the evaluation results:

- Improved licensing model would foster world-wide provisioning of European commercial solutions
- Timely access to operational data and software is an enabler (access to data/software entails all what is needed for use as baseline for commercial solutions and services)
- Considerable demand has been voiced for rapid provision of technical support from ESA ground segment experts to companies, beyond the current technology transfer support to startup companies
- Development of a platform to provide operational data and reference solutions to allow test and validation of commercial systems for various mission scenarios, including deployments of commercial solutions and their validations in shadow operations is an enabler for commercial success

The results and considerations from the survey, market analysis and open call activities in 2023 and 2024 have contributed to the shaping and evolution of ESA commercialisation offerings. Advancing Solar System Internet and Ground (ASSIGN) is a new optional programme element that will be proposed to the ESA Council at Ministerial level in November 2025. The ASSIGN programme proposal has embraced the above recommendations for fostering the development of commercial solutions in Ground Segment with focus on advancing the concept of Solar System Internet.

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