➔ PREPARATION

PREPARATION ACTIVITIES OF LAUNCH SERVICES FROM EUROPEAN PRIVATELY DEVELOPED MINI/MICRO LAUNCHERS OSIP CAMPAIGN

Executive Summary Report

pre-phase A system study

Affiliation(s): Rocket Factory Augsburg AG

Activity summary:

Within this initiative ESA aims to identify and evaluate the capabilities of privately developed small launcher services, assess their robustness and help prepare them to become ESA's potential providers. This report introduces Rocket Factory Augsburg (RFA) and elaborates on the current development status of the RFA ONE launch system, targeting its first launch in 2024. It further assesses the industrialization and commercialization of the launch system and concludes with the well-suited capabilities to enable not only the DRACO and LUMIO, SATIS and LEO-PNT ESA missions thanks to the key advantages of cost-effective design and flexibility of the launch system.

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Rocket Factory

EXECUTIVE SUMMARY REPORT

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Introduction

This Executive Summary outlines the key findings of the feasibility study by Rocket Factory Augsburg (RFA) on the preparation activities of launch services from European privately developed Mini/Micro launchers OSIP campaign.

ESA is interested in launch services from European operators of European privately developed launch services for its mission needs. Within the frame of this OSIP campaign the aim is to identify the capabilities of European companies, assess their robustness and help prepare them to become ESA's launch service suppliers.

Rocket Factory Augsburg was founded in 2018 with a vision to facilitate data-driven business models in space, RFA strives to enhance Earth monitoring, protection, and connectivity. Central to our mission is the goal of offering launch services into low Earth orbits and beyond at unprecedented prices, thereby reducing launch costs and democratizing access to space.

RFA is currently developing the RFA ONE launch vehicle, targeting its first test flight in 2024. With its payload capabilities it is well suited for the referenced ESA missions DRACO, LUMIO, SATIS and LEO-PNT.

The activity report elaborates on the current development status of the launch system and the roadmap toward its first launch and extending to the referenced ESA missions, its industrialization and commercialization. Once in commercial service, RFA expects the RFA ONE launch service to be a perfect fit to serve ESA's future missions, including the most ambitious.

RFA ONE Launch System

RFA ONE's 3-stage-to-orbit launch system architecture, with two stages and the Redshift OTV acting as a third stage, enables both greater performance and orbital flexibility. The RFA ONE launch vehicle utilizes highly efficient staged combustion engines developed by RFA enabling more payload performance compared to commonly used open-cycle engines. Staged combustion engines (Helix engines) are used in both the first and the second stages of RFA ONE. By leveraging advanced propulsion technology, RFA is assured to redefine the capabilities and cost-effectiveness of space launch operations, further solidifying its position as a leader in the space industry.

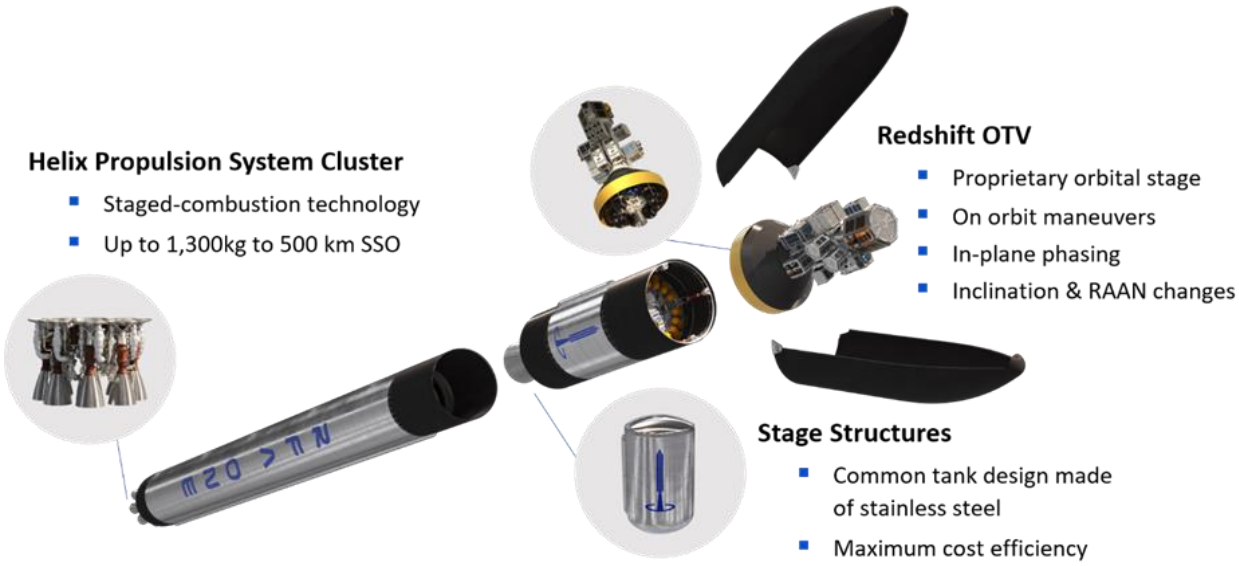

Figure 1 : RFA ONE systems overview

Another key enabler for the ESA missions of this call is the Redshift Orbital Transfer Vehicle (OTV) which allows for such missions also beyond Low Earth Orbit (LEO) from a relatively small launch system. With Redshift, RFA sets a new standard in space mission flexibility and efficiency. Unlike conventional OTVs carried as separate payloads, the Redshift OTV is seamlessly integrated into RFA's launch system, enabling fully customized and complex missions tailored to diverse orbital requirements. From deploying constellations in LEO to navigating spacecraft to high-energy orbits like MEO, GTO, and beyond.

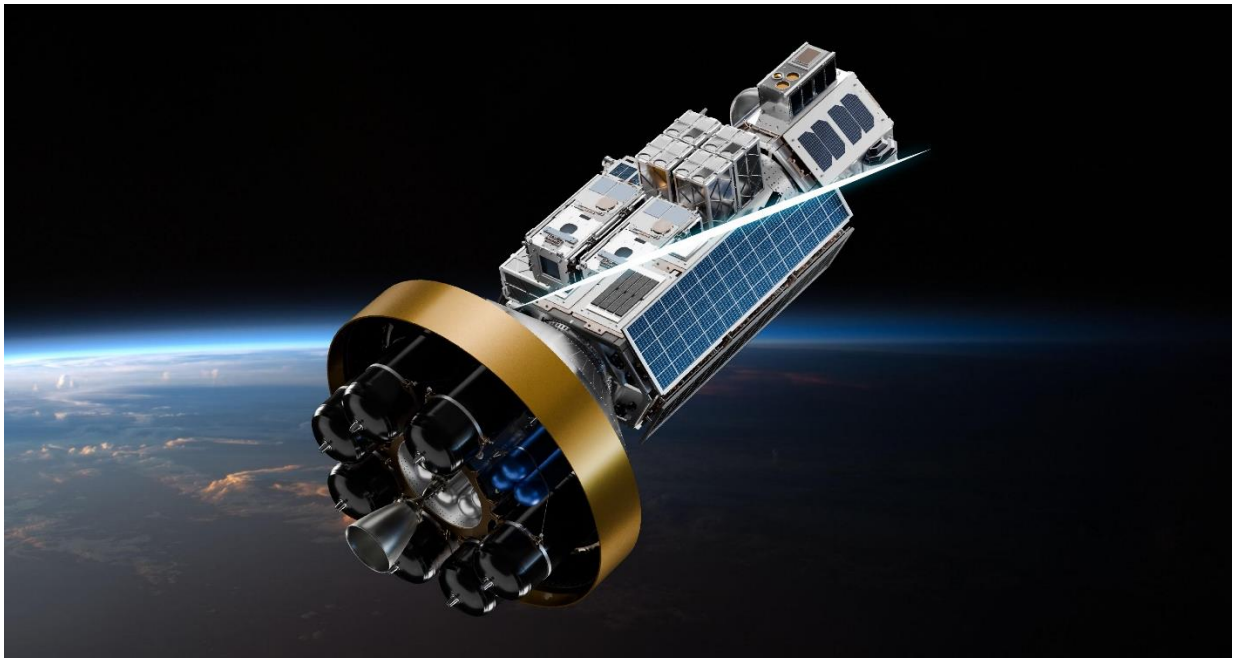

Figure 2: Redshift exemplary configurations

RFA prioritizes environmental aspects and space debris mitigation. The RFA ONE launch system's three-stage architecture uses non-toxic liquid propellants and was designed with debris mitigation in mind, aligning with ESA and sustainable space activity standards.

Study Approach

RFA with its RFA ONE launch system demonstrates its robustness through technical advancements, commercial positioning, and financial stability in the launch services market. A preliminary mission analysis including trajectory calculations and interface definition was conducted to customise RFA’s launch services to meet the specific requirements of four ESA missions: DRACO, LUMIO, SATIS, and LEO PNT. Furthermore, to evaluate potential gaps in both the vehicle technology or the launch service capability, a comparison overview for the 4 respective missions was created. A roadmap has been outlined to address the successful development and deployment of RFA ONE in particular the services for this call.

Findings

The analysis performed within this study shows that all ESA missions of this call can be realized with the RFA One launch system thanks to its particular capabilities for a small launcher. The RFA ONE launch vehicle emerges as the optimal choice for the DRACO, LUMIO, SATIS, and LEO-PNT missions. The three-stage architecture including the Redshift OTV offers or exceeds the required payload capacity, low-cost solutions, and flexibility, with interfaces aligning well with mission requirements. A preliminary structural analysis confirms the compatibility for all

payloads referenced in the call. Also, the RFA facilities already in place and nearing completion are suitable for supporting these missions.

For DRACO, RFA's flexibility in selecting impact locations sets it apart from other launch services. For LUMIO, RFA ONE can deliver the payload to a highly elliptical transfer orbit to the Moon, with launch options from Kourou and SaxaVord. For SATIS, Redshift's remarkable delta-V performance maximizes payload delivery, with flexibility in burn sequences. For LEO-PNT, Redshift's RAAN shift capability efficiently places satellites into separate orbital planes, with a short mission duration and optional de-orbiting burn for space debris mitigation.

Gap Analysis

The RFA ONE launch system can realize all mission in the call by combining two key competitive advantages: A customer-focused service with precise in orbit delivery and a high degree of mission flexibility through its Redshift OTV; at a highly competitive price made possible by superior staged combustion technology, low-cost structures and usage of industrial components. One of the key enablers for this is the three-stage architecture of RFA One that provides enough payload mass capacity, not only to LEO but also beyond such as in the SATIS and LUMIO missions.

The main launch site for RFA ONE is located on Unst in the Shetland Islands, with SaxaVord Space Port as the launch site operator partner. The site will be operational in summer 2024 for the first flight of RFA ONE and will keep being improved for increased capabilities for customers also such as the ESA missions of this proposal.

To provide lower inclination launch, as well as increased launch capacity with simultaneous launches and an increased number of missions together with geographic flexibility and risk reduction, RFA signed in March 2023 a binding term-sheet with the Centre National d'Etudes Spatiales (CNES) to secure launch operations from 2025 onwards from the Diamant launch complex (ELM) in Guiana Space Centre (CSG). The project is currently in implementation.

As environmental aspects of the launch system and space debris and its mitigation is becoming increasingly important not only for ESA but any sustainable actor in space activities, RFA also takes this topic very seriously. The overall launch system design of RFA ONE is very favourable for this with its three-stage architecture of non-toxic liquid propellants, and has had debris mitigation in mind during design phase already. In general, RFA follows industry common best practice for safety design and procedures. As part of the launch system, Redshift will release the payload on orbit without the use of any debris generating separation systems. After having performed the primary mission goal of payload separation, Redshift generally has the capability to deorbit itself and thus leave no remaining launch vehicle elements on orbit. In conclusion the “ESA Space Debris Mitigation Requirements” [ESSB-ST-U-007, baseline]” has been considered for the design and the launch systems will be compliant to this.

RFA has conducted a detailed environmental impact assessment as part of their launch licensing activities in the UK, which is, together with the flight safety system, a central element of the licensing activities.

Roadmap

The following roadmap highlights the major milestones for the launch service development for the four ESA missions of this call. It starts with the final steps before the first launches of RFA ONE to be happening in the next few months.

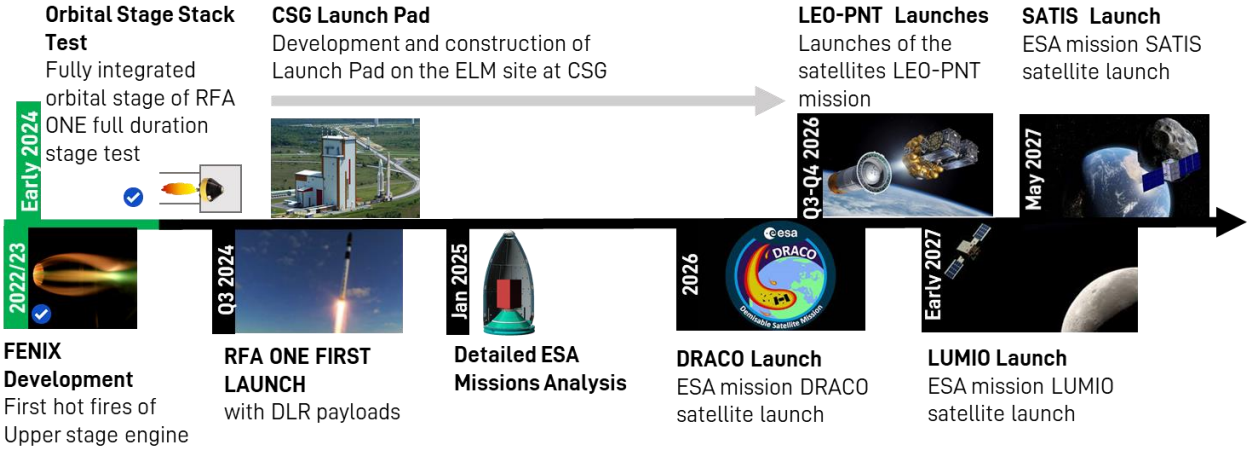

Figure 3: Development Roadmap of RFA Launch Services for ESA Missions

Pending further communication of CNES, the development of the CSG launch pad is planned to get to the next phase over the course of the year 2024. Once the planning and agreement is completed, the construction and commissioning of the launch pad, in analogy to the recently completed launch pad at SaxaVord, is foreseen for 2025. This will allow a launch readiness for the missions requiring the low inclination launches, such as SATIS and LUMIO, at the end of 2025 or early 2026 as per current communication from CNES.

In the case of project kick-off for the launch of the missions, detailed mission analysis and manufacturing of the launch vehicles will start in 2025.

Conclusion

With anticipation for the upcoming first launches, RFA is confident in the thoroughness of its mission feasibility assessment performed in the frame of this activity. Following this preliminary analysis RFA concludes that all four ESA missions of this call can be provided with the current development of RFA ONE launch system approaching qualification in the course of 2024.

RFA ONE's robust launch system offers significant competitive advantages, including customer-focused service, exceptional mission flexibility, and cost efficiency. Comprehensive mission analysis confirms RFA ONE's capability to undertake various ESA missions, with its advanced three-stage architecture and Redshift OTV enabling precise in-orbit delivery and extended mission durations. The roadmap provides next steps from a potential launch service agreement forward to enabling the launch services addressed in this call. With strong internal capabilities, clear strategic planning, and unwavering commitment, RFA is confident in its ability to deliver reliable and efficient launch services, contribute to sustainable space exploration, and supporting the ESA mission of this call.