

Aerospace Europe Conference 2023

Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX (to be filled by the organizers)
Preferred Topics: NEWSPA / SUSTSP / REUSYS
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Type: Oral
Status of corresponding author: Regular

Enabling a European In-Space Transportation ecosystem

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Abstract

The boom of NewSpace and its start-up ecosystem, alongside the evolution of the space market linked to constellations and to new destinations as the Moon and Mars, is challenging the traditional space transportation approach based on “point-to-point” missions with tailored launchers. ESA market and system studies [1] indicate that the most cost-effective and performant space transportation system on the 2025-2050 horizon could rely on an optimised fleet of reusable launchers injecting payloads on high parking orbits, combined with a “hub and spoke” space logistics network to reach the final orbits (e.g. constellations phasing, exploration missions...) and provide transportation support for in-orbit servicing. Such an ecosystem will be a system-of-systems involving a portfolio of interoperable In-Space Transportation Vehicles (ISTVs) integrating standardised interfaces to ensure their interactions.

To foster the emergence of such a European in-space transportation ecosystem, that is considered as a potential game-changer for access to space, ESA Future Space Transportation is enabling its required space transportation capabilities, as rendezvous & docking and in-orbit refueling, using incremental In-Orbit Demonstrations over the coming years.

Following a competitive tendering, five parallel contracts are on-going on the Phase 0/A studies of Proof-of-Concept 1 (PoC-1) on in-orbit rendezvous and docking [2]. Their objective is to perform a state-of-the-art survey then trade-off on the enabling interfaces (mechanical & electrical docking interfaces, operational & GNC protocols, communication standards...), to foster a convergent approach on their standardisation, and to perform the conceptual design of the PoC-1 system-of-systems for its In-Orbit Demonstration between two ISTVs. These contracts are led respectively by D-Orbit, OHB System, S.A.B. Aerospace, Thales Alenia Space, and The Exploration Company as Prime contractors.

This paper provides a synthesis of the outcomes of these Phase 0/A studies on PoC-1: in-orbit rendezvous and docking. The considerations and designs of the required interfaces will be presented and discussed, to pave the way for the standardisation of these building blocks that are cornerstones for the emergence of this end-to-end space transportation ecosystem. The ESA roadmap on in-space transportation will be continued with the next steps of PoC-1 up to its In-Orbit Demonstration and the launch of first phases of PoC-2 on in-orbit refueling for reusables space tugs.

References

[1] “ESA defines elements of future European space transportation solutions”

https://www.esa.int/Enabling_Support/Space_Transportation/ESA_defines_elements_of_future_European_space_transportation_solutions

[2] “ESA sets sights on space transportation ecosystem”

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