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TRAILBLAZER, THE FIRST COMMERCIAL SATELLITE REFUELING MISSION

Abstract

Commercial aircraft today may be refueled up to 40,000 times throughout their life. Automobiles could be refueled 750 times. Even launch vehicles are now being refueled 10 times or more. But satellites are never refueled. Satellites in operation today are frequently lifetime-limited by fuel capacity; even if the hardware is operating nominally, the spacecraft is discarded when it runs out of fuel. Additionally, the inability to refuel limits a satellite's ability to perform high delta-V maneuvers. Satellite refueling will drastically improve mobility and sustainability, critical components of a bustling in-space economy that must be addressed today in order for our in-space goals to be realized in the coming decades.

The Orbit Fab Trailblazer Mission, launching in mid-2023, will be the first commercial satellite refueling mission. Trailblazer will consist of two satellites containing hydrazine propellant, both designed for satellite rendezvous, proximity operations, and docking (RPOD) and refueling. The satellites will launch to low-Earth orbit (LEO), which was selected for this first refueling mission as many elements of spacecraft operations are most straightforward for satellites in LEO. One of the satellites will refuel the other to demonstrate RPOD between small spacecraft, as well as docking and fluid transfer with Orbit Fab's refueling interfaces - the passive side known as the Rapidly Attachable Fluid Transfer Interface (RAFTI), and the active side known as the Grappling and Resupply Interface for Products (GRIP). Both RAFTI and GRIP will have flown to space separately on previous missions. RPOD maneuvers will be shared publicly prior to execution, enabling independent verification of RPOD operations and setting a precedent for future satellite RPOD activities across the space industry. After the first refueling between Orbit Fab satellites, both satellites will be capable of refueling any other hydrazine-fueled spacecraft equipped with RAFTI starting in late 2023. Trailblazer will build upon Orbit Fab's Tanker-001 Tenzing, the first fuel depot that launched to LEO in June 2021, to establish a robust in-space propellant supply chain and refueling infrastructure.

This paper provides an overview of mission accomplishments to date, and summarizes the next steps towards the launch of the Orbit Fab Trailblazer satellite refueling mission. This mission is a major step towards Orbit Fab's vision of a ubiquitous, rapid propellant supply chain in Earth orbit and beyond. Ubiquitous access to propellant in orbit will reduce the cost of operating spacecraft and enable classes of missions which were previously infeasible due to fuel life restrictions.