IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (2)

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DESIGN OF A SHUTTLE AND DEPOT ARCHITECTURE FOR RELIABLE AND COST-EFFECTIVE REFUELING OPERATIONS IN ALL ORBITS

Abstract

As the space industry grows, the number of missions and ConOps have expanded greatly, with greater demand for fuel across orbits. Geostationary Orbit (GEO), which traditionally has been an orbit that is very difficult to access and operate within compared to Low Earth Orbit (LEO), is quickly becoming one of these regions. With the recent announcement of the fuel sale agreement for Orbit Fab to deliver fuel to Astroscale in GEO in the late 2020's, and many other refueling discussions and term sheets in the works, Orbit Fab has committed to developing the required infrastructure to make this GEO refueling vision possible. One of the major steps in this is the GEO Pathfinder Mission being coordinated by Spaceflight Inc. and GeoJump, scheduled to launch in Q4-2022/Q1-2023 and includes Orbit Fab's Kutter Payload, named after the late Bernard Kutter who was instrumental in the socialization of propellant depots for commercial space as the manager of advanced programs at United Launch Alliance. This Kutter payload contains a number of different pieces of hardware, avionics, and software building off of the Tenzing mission which launched last year in 2021 intended to mature Orbit Fab's manufacturing, on-orbit experience, operations, and flight legacy. Orbit Fab's Kutter payload will include critical subsystems for operational testing in the Geostationary environment. The flight avionics will validate motor control and fluid systems control built on a radiation hardened architecture. Kutter will include GRIP, Orbit Fab's active docking and fluid coupling mechanism, to test operations and assess performance in a flight environment. The vision system and fiducial plate will also be analyzed on this mission to obtain data on resolution and image capture across the mission's operational lighting conditions for future rendezvous. Additionally, the fluid storage and transfer system architecture will be validated through mission operations and provide a

test bed for transfer operations and performance until the propellant is pulled out on a future servicing mission. Further, the transfer and final orbits are an operational test for future architecture, with a unique Lunar fly-by delivering Kutter to an orbit above GEO, called GEO+. GEO+ is the planned orbit for fuel depots, allowing precession and frequent access to spacecraft in various longitudes. The required ground operations and communications will be examined on this mission. This paper will further explore the details of this mission along with how it contributes to the building blocks of a bustling space economy.