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From Earth Missions to Deep Space Exploration (05)
Cis-Lunar Outposts and other Exploration Missions (5)

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ON-ORBIT SATELLITE SERVICING: LAYING THE FOUNDATION FOR HUMAN EXPLORATION BEYOND LEO

Abstract

On-orbit servicing and assembly of space assets is a critical capability and stepping stone to human exploration beyond low earth orbit. The ability to repair LEO satellites on orbit has long been established with Shuttle based repairs beginning with Solar Max in 1984 and continuing through the five Hubble Servicing missions. Assembly of the International Space Station has been touted as one of the greatest engineering feats of human kind. The ISS continues to be routinely maintained and enhanced through a combination of human and robotic servicing activities.

As we advance beyond LEO, servicing will remain a critical capability. The first small steps will likely involve servicing. Following Space Shuttle retirement, a human satellite servicing mission later this decade, using either MPCV or commercial crew vehicles, could signal the return of non-ISS focused human space operations and begin a sequence of missions venturing to higher destinations. This paper will discuss the human exploration context for both robotic and human on-orbit spacecraft servicing.

Servicing includes inspection, repair, relocation, refueling, component replacement/upgrade, and in-space construction. Robotic inspection services would provide damage assessment and facilitates planning for subsequent human and robotic operations. Repair may involve releasing a jammed deployable. Relocation is the movement of space assets. There have been numerous concepts promulgated for a "space tug" to transport space assets to the ISS or to higher orbits from the ISS, for example. Tugs may also be necessary to dispose of depleted space assets or other debris posing hazards to human or robotic space operations. Refueling involves opening and closing valves and transferring fluids. This could extend the lives of spacecraft low on propellant but in otherwise good condition. Refueling capabilities could also support fuel depot human transportation architecture or resupply coolant for active thermal control systems. Spacecraft components and science instruments can also be repaired or replaced allowing infusion of newer technologies. Finally, servicing capabilities enable the in-space assembly of large structures, such as the ISS, or future large optical telescopes and spaceships for human explorers traveling to near-earth objects or Mars.

A robotic satellite servicing capability is a critical element in the emerging space commerce. Commercial space servicing capabilities provide needed infrastructure enabling human exploration beyond LEO. Commercial tugs and servicers could enable movement and repair of space assets and assist with in-space construction. A commercial servicing infrastructure could reduce the overall costs of space operations and support human exploration objectives.