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IMPLICATIONS AND BENEFITS OF A ROBUST LUNAR GATEWAY

Abstract

Human spaceflight is readying for its next great step where humans will once again venture beyond Low Earth Orbit (LEO). NASA is moving forward with lunar surface exploration, with sights set on an established sustainable presence on and around the moon. Under NASA's leadership, the concept of a Gateway spacecraft orbiting the moon has developed as an enabler of all human exploration options, to get to the moon and build a path to Mars. We agree that Gateway is key to sustainable lunar and Mars exploration.

The Gateway, a small human-tended facility around the Moon, supports many near term exploration goals, including human and robotic lunar exploration. Gateway is the ideal launching off and return point for lunar surface missions, serving as an aggregation, refuel, and resupply point for a reusable ascent element and a safe parking location for the crew Earth return vehicle. It is, similarly, ideal for Mars missions by offering a location for the assembly of Mars transit vehicles and a place to refuel and restore vehicles that have returned from Mars.

Direct exploration of the lunar surface, i.e. not through the Gateway, provides opportunity to demonstrate developing technologies at a lower short term cost and may be appropriate for initial missions. However long term affordability benefits from residual architecture for use in future endeavors. While the Apollo program was a crowning achievement in US spaceflight, it left no residual hardware behind for future use. This approach has left us now in the position of having to start future lunar exploration from scratch. Building a robust and sustainable architecture, such as a Gateway, enables future options and programs and avoids future costs. Most critically, commercial interests are more likely to appear in deep space when there is existing infrastructure to support them and defray mission costs.

This paper discusses the implications of various choices in a lunar exploration architecture and will examine the role of a Gateway in a robust lunar exploration program. The importance and value of a Gateway to all exploration options will be examined and compared to direct exploration of the lunar surface; this includes the value of supporting parking, reuse, and refurbishment of other exploration elements. The paper describes how investments in lunar exploration provide maximum value by leaving a residual architecture to enable commercial endeavors and provide maximum cost benefit both during and after lunar exploration.