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A FLEXIBLE CISLUNAR ARCHITECTURE ENABLING LUNAR SURFACE EXPLORATION AND MARS EXTENSIBILITY

Abstract

Discussion in the global space community continues to focus on extending human presence beyond low Earth orbit to lunar space and beyond. International cooperation has brought much success to the ISS program and will likely produce additional elements for these future exploration missions. There is broad, though not universal, agreement that cislunar space is the appropriate first destination as a location that enables multiple objectives and provides excellent extensibility.

Boeing continues to study exploration architectures that both create a firm foundation for a sustained exploration program and provide a steady cadence of mission goals. These architectures are based around the capabilities of the SLS for heavy lift and Orion for crew transport, which includes the capability to deliver both crew and cargo to cislunar space in a single launch. This paper describes the results of Boeing's current architecture study that examined in particular the impact a robust lunar surface exploration would have on a cislunar platform and the basic elements required for a lunar surface architecture.

The capabilities provided by the ISS today to test, develop and mature deep space hardware and operations are critical to future human space exploration and hardware developed for ISS is leveraged in the Boeing architecture whenever possible. Existing satellite technology is also highly suitable for deep space human exploration and the cislunar architecture begins by taking early advantage of both. The cislunar vehicle must support lunar surface operations, in particular hosting a reusable lander, as well as other potential missions such as investigating a captured asteroid. These kinds of operations drive the basic design and capabilities of the cislunar outpost.

This study showed that an incremental, extensible and enduring exploration architecture that enables early lunar surface access while supporting Mars extensibility is both feasible and affordable. The capabilities and sequence of the in-space and surface elements are presented and discussed and the particular impacts of lunar surface operations to the in-space vehicle are noted. Extensibility of lunar surface elements to Mars surface elements are compared. Possibilities for international and commercial contribution opportunities to further the cooperation and partnerships established through the ISS and other NASA programs are listed. The Boeing architecture demonstrates that major near term objectives, such as lunar surface exploration, are entirely possible within an architecture that steadily builds towards a Mars capability.