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MARS MISSIONS ENABLED BY CISLUNAR ARCHITECTURE AND TECHNOLOGY DEVELOPMENT

Abstract

Multiple agencies and industry partners are defining concepts to extend human presence in lunar space and beyond to Mars. Architectures for lunar space exploration should provide flexibility and resiliency to meet the objectives of multiple partners and demonstrate technologies for future missions. Mission readiness is demonstrated through selection and testing of applicable spacecraft technologies and operation techniques. Lunar proving ground missions will, by their nature, mature promising technologies but must be able to accommodate and adapt to changing international budgets, priorities, schedules and unforeseen challenges.

Boeing's cislunar proving ground architecture and operation concept addresses these fundamental goals and is based upon the heavy lift capability of the Space Launch System (SLS) and the integrated capability to co-manifest a 10t element with Orion on a single launch to cislunar space. The architecture seeks to maximize utilization of available capabilities to maintain a consistent human cislunar presence and develop Mars mission readiness. Key technology and operations demonstrations include deep space environment mitigations, advanced closed loop ECLS systems, electric propulsion, automated rendezvous docking, operating with significant communications lag and telerobotic operations.

This paper describes the elements and concept of operations of the Boeing architecture and analyzes the extent to which the architecture enables the demonstration of technologies and mission operations required for a Mars mission. Key elements of achieving that flexibility include distribution of key functions of space craft CDH, attitude control, basic life support, etc among initial modules such that the architecture can support launch order independence. The use of a modular plug and play architecture allows other subsystems that are supported in a single element only to be integrated late in processing flow. Standards for interfaces such as data, power, docking, rendezvous, and communication allow for multiple commercial and international partners to develop and integrate their own enabling technologies/subsystems. The Boeing architecture demonstrates that near term objectives, such as lunar surface interactions and asteroid exploitation, can be accomplished while steadily building a Mars capability.