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# GATEWAY HABITAT EXTENSIBILITY TO THE LUNAR SURFACE AND MARS

**Abstract**

Through an international effort, multiple space agency and industry partners are defining concepts to extend human presence in lunar space and beyond to Mars. Integral to this effort is definition of a lunar Gateway outpost that orbits the moon and serves as a base for exploration of the moon and Mars. Through a series of analysis cycles informed by studies with industry partners, NASA requirements for the Gateway and its modules have begun to advance and solidify. The concepts defined now will be the basis of future exploration on the lunar surface and to Mars. A thoughtfully designed Gateway habitation module should feed forward to surface habitation and Mars exploration; design and system extensibility should be a basic Gateway implementation goal. Architectures for lunar space exploration must provide flexibility and resiliency to meet the objectives of multiple partners and demonstrate technologies for future missions. The Gateway and habitat module will be the test bed for technologies for lunar and Mars which, once proven, will need to be useable on multiple platforms. The primary structure itself should be a forward-looking technology with capability for subsequent lunar and Mars missions, whether the same module or a second unit or even a second generation module. NASA can maximize returns through careful technology investment and planning for early system demonstration and evolution. Boeing continues to study exploration architectures that both create a firm foundation for a sustained exploration program and prepare for future mission objectives. 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 the Gateway platform and the basic elements required for a lunar surface architecture. As always, the architectures must mature promising technologies and operations techniques for deep space, provide a steady rhythm of accomplishments, produce an extensible architecture for exploration beyond lunar space, and fit within international budgets, priorities and schedules. 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. This paper discusses extensibility scenarios and considerations for requirements to allow designs to feed forward.