

Lunar Exploration (2)  
Lunar Exploration (1) (1)

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## ARCHITECTING A SUSTAINABLE LUNAR INFRASTRUCTURE

### Abstract

As part of the Artemis era of space exploration, space agencies will be working together with their industry partners to establish systems and infrastructure that enable sustained lunar missions and develop capabilities for Mars. The planning for this next phase is possible now that Orion and the Space Launch System are about to perform their initial missions together, the initial Gateway elements are in design and production, and the set of regular lunar robotic landing missions from a diversity of countries and companies has begun. Each mission to the lunar surface, both crewed and robotic, offers the opportunity to demonstrate new technologies and operations. These new technologies and operations enhance exploration and scientific discovery, mature those same capabilities for Mars, and build upon previous missions. Unlike in the Apollo era, the focus is on the long-term placement of a diverse set of new infrastructure that supports a sustained lunar presence. Another difference from the Apollo era will be a focus on providing infrastructure capabilities as commercial services to a diversity of customers.

This paper will explore the build-up of this lunar infrastructure. First, it will provide a conceptual surface systems architecture design that encompasses power, in-situ resource utilization (ISRU), habitation, and mobility systems. Because this infrastructure is a key aspect in supporting a budding lunar economy, the focus of the architecture development will be on key systems, technologies, and solutions that can both enable the Artemis missions and provide the basis for a lunar economy. It will assess potential growth in power and resource needs as the lunar economy grows, and explore how modularity and adaptability in the infrastructure can enable that growth. For example, initial power systems can provide supplemental power to Artemis elements, and also grow in a modular fashion to provide power as a service to commercial missions. Initial ISRU demo capabilities could provide crew consumables, and grow over time to provide propellant and manufacturing materials. Lastly, this paper will assess how architectures could adapt from supporting the initial phase of the Artemis program that emphasizes exploration and mobility to a phase of the Artemis program that emphasizes sustained presence and Mars mission support.