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Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

Author: Dr. Michael Nayak
Defense Advanced Research Projects Agency, United States

Ms. Ashley Batjer
Defense Advanced Research Projects Agency(DARPA), United States

LUNA-10 FRAMEWORK FOR THE FUTURE COMMERCIAL LUNAR ECONOMY

Abstract

What will a post-Artemis thriving lunar economy look like? What are the so-called "building blocks", or foundational technology nodes, that require investment now to realize the self-sustaining lunar economy of the future? How will the interfaces of major lunar services interact? How can industry members share resources to create sustainable services on the moon? These are the questions the 10-Year Lunar Architecture (LunA-10) Program at the Defense Advanced Research Projects Agency (DARPA) aimed to answer. Fourteen industry-leading companies, U.S. and international, were assembled to approach these fundamental questions: Blue Origin, CisLunar Industries, Crescent Space, Fibertek, Firefly Space, GITAI, Helios, Honeybee Robotics, ICON, Nokia, Northrop Grumman, Redwire, Sierra Space, and SpaceX.

Looking from a 10-year technology development perspective, several commercial and government organizations have expressed significant interest in and developed roadmaps for a sustained lunar presence in accordance with the Outer Space Treaty. With NASA's Artemis mission underway and several companies sending commercial payloads to the lunar surface on Commercial Lunar Payload Services (CLPS) missions, the current vision centers around standalone missions. Each company would bring their own power, their own communications, and their own transportation to complete their mission, augmenting both cost-to-launch and risk of equipment failure. In shifting the paradigm from isolated missions to multi-service, shareable services on the lunar surface, many new operational considerations must be made. For example, understanding power services to accommodate several classes of users, a transportation network to accommodate several sizes of spacecraft, or how waste of lunar processes can feed others to reduce the overall launch cost. These technology gaps, and dozens more, must be addressed before a commercially-owned and -operated lunar economy is established, especially one that can sustain independently of government funding.

The LunA-10 Program, which concluded in July, produced a series of analytical frameworks describing major lunar commercial services and how they may interface in a business case that closes. These services include power, communications, in-situ resource utilization (ISRU), robotic construction, and more. From here, DARPA has uncovered areas of technical capability gaps that could spur further investment. The final paper will include such an analytical framework, accompanied by a discussion of how we arrived at this end-state.