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ARCHITECTING THE LEAP FROM MOON TO MARS

Abstract

The November 2022 launch of NASA's Space Launch System rocket and Orion crew vehicle marked a major milestone in Artemis, the NASA-led international effort to return humans to the Moon. The next mission, Artemis II, will see astronauts return to lunar orbit for the first time since Apollo 17 in 1972, and Artemis III will be humanity's first lunar landing in over half a century. But these next steps are just the beginning – far greater in scope and ambition than the Apollo program, Artemis will see astronauts return to the Moon not just for brief sortie stays, but to establish a sustained lunar human presence, initially in lunar orbit on the Gateway platform, and ultimately through the establishment of Artemis Base Camp on the lunar surface. And, even then, Artemis itself is only the first stage of a larger campaign of exploration that will next see astronauts leave our Earth-Moon system for our first visits to another planet, Mars. If Artemis differs from Apollo in the ambition of its goals, it, and the Moon to Mars campaign, are also quite different from Apollo in terms of the methods through which they will be executed. While Apollo was a fully NASA-managed effort to make the United States the first nation on the Moon, Artemis is a NASA-led effort to establish an international presence on the Moon, and involves working with numerous commercial and international partners. In addition, Artemis will see the development of a broader portfolio of exploration systems, including not only SLS and Orion, but also multiple Human Landing Systems, the Gateway lunar orbit facility, spacesuits, surface mobility systems and habitation systems. As humanity moves from the Moon to Mars, even more robust capabilities and additional systems will be required. Overseeing the large number of systems and participants requires a robust architecture approach, managing the numerous interfaces between the systems and identifying the gaps that need to be addressed in undertaking this ambitious endeavor. This paper will provide an overview of the Moon to Mars architecture and the work being done by Marshall Space Flight Center's Exploration and Transportation Development Office to facilitate our return to the Moon and first steps on another planet.